PUBLIC WORKS

Sept. 1952

What to do About Pavements at Bus Stops

How to Use Porous Plates for Water Filters

A Small City Can Afford Good Sewage Treatment

A New Idea for Better and Stronger Concrete

Lessons in Brush Control from Louisiana's Canals

Street Oiling Program
Pleases the Public



Warren A. Coolidge, Director of Public Works and City Engineer of Nashville, Tenn., has supervised rebuilding of 250 miles of streets and nearly 40 miles of sewers over the past four years. More on page 18.

Why pay "EXTRA"? - for features that GALION qives as STANDARD EQUIPMENT

WHY ACCEPT LESS?

Galion standard equipment on Models 118, 104 and 203 Motor Graders include —

- Same large-size, low pressure tires front and rear. They give better flotation and traction on soft ground . . . higher front axle clearance . . . and greater stability in blading operations.
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ESTABLISHED 1907 MOTOR GRADERS • ROLLERS

THE GALION IRON WORKS & MFG. CO., General and Export Offices — Galion, Ohio, U. S. A. Cable address: GALIONIRON, Galion, Ohio



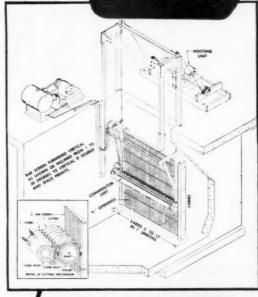
Chicago Pump, the company that developed and perfected the Comminutor, announces the new Chicago Barminutor for plants with flows of 15 MGD and over. The Barminutor combines the function of a bar screen with the unfailing performance of the Comminutor. It can be installed in existing open channels. Complete technical data sent upon request.

BARMINUTOR OPERATION . . .

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Revolving cutters (1) traveling in slots on bar screen (2) pick up coarse sewage matter from screen and carry it to combs (3) against which it is cut into small pieces. Cutter assembly rotates at 200 rpm, and moves up and down the bar screen at 1 fpm.

Chicago



Chicago-Selas

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SEVENE

SURVEY

A new, modern and compact system of sludge heating has been developed by Chicago Pump Company in conjunction with Selas Corporation of America. The system utilizes the old, reliable and direct method of heat transfer by submerged combustion and applies it to sludge heating. The method is characterized by compactness and simplicity of equipment, high efficiency, flexibility and ease of control. This advanced process accomplishes these major improvements.

- 1. Complete sludge digestion on an established schedule.
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- 3. Maximum use of digester capacities.
- Accurate and regulated heating of digesting products.
- 5. Efficient direct heat transfer.
- 6. Economical and automatically controlled.

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522 DIVERSEY PARKWAY

Flush Kleen, Scru-Peller, Plunger Horizontal and Vertical Non-Clogs Water Seal Pumping Units, Samplers



CHICAGO 14, ILLINOIS

Swing Diffusers, Stationary Diffusers, Mechanical Aerators, Combination Aerator-Clerifiers, Comminutors.

CITY SERVICE for SANDPOINT

International TD-14A is jack-of-all-trades

Sandpoint, Idaho, had nearly given up on some of its streets buried under snow as high as house porches. Existing snow removal equipment couldn't break through. That was when the city's new International TD-14A took charge.

Next morning, Sandpoint awoke with its streets restored and traffic moving normally, something that hadn't happened in many a severe winter. And Sandpoint's new International works on roads and other maintenance all summer.

Operator Harold Tibbs was sold on this TD-14A the first day. He says: "It's quite a machine, and sure is easy to handle. I was never on dozers more than 20 hours all told and I'm operating this new TD-14A without any trouble, opening up roads they've given up on because other equipment couldn't get through."

Like Sandpoint, your city can stay far ahead of maintenance problems with International power. Ask your International Industrial Distributor about the many ways International can help your city be a better place to live while saving the taxpayer's money.

See him today and keep in mind that his trained servicemen and up-to-date shop facilities will keep your equipment primed for any civic emergency.

INTERNATIONAL HARVESTER COMPANY, CHICAGO 1, ILL.







INTERNATIONAL TD-14A opens snow-blocked streets of Sandpoint, Idaho, after other equipment fails to clear them. Harold Tibbs, with only 20 hours' experience operating crawlers, has no trouble putting the rugged red crawler to work the first day.

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Edited by W. A. Hardenbergh and A. Prescott Folwell



CONTENTS

SEPTEMBER 1952

	Industrial Wastes in the Metropolitan New York Area	50
	Few Customers, Large Pumpage at Groton Water Works. By L. F. Dutton	53
	Street Oiling Program Pleases Public. By C. C. Fagerlind	56
	A Small City Can Afford Modern Sewage Treatment. By C. N. Harrub	59
	Get Better Operation Designed In Your Next Plant. By Bernard Westkamper	60
	What To Do About Pavements at Bus Stops. By Frank P. Horan	61
	How to Use Porous Plates for the Modern Water Filter. By F. C. Roe	63
	Trench Drill Speeds Laying Pipe Under Roads	65
	Studies in Composting Organic Refuse	66
	Dual Fuel Engine Saves \$25,000 a Year	67
	The Key to Better Brush Control. By W. D. Beck	68
	A New Idea for Better Concrete. By William J. Anderson	70
	Refuse Disposal by Sanitary Fill. By Robert L. Anderson	74
	Machines Do the Work Faster and Cheaper	75
	Compacting with Track-Laying Tractors	76
	Ohio Water Resources—A Clinical Report	78
	Ground Cover Plants for Roadside Erosion Control	82
	Skid Resistance in Different Pavement Surfaces	86
	Repairing Leaky Joints in the Winnipeg Aqueduct	88
	Hollow Sidewalks a Problem in Street Widening. By John Hubel	89
	Diatomite Filters for a Swimming Pool	89
	Mobile Unit for Highway Study	102
	Rail Cutting Aids Street Improvement	106
•	PUBLIC WORKS DIGESTS	
	The Water Works Digest	95
	The Highway and Airport Digest	
	The Sewerage and Refuse Digest	107
	DEPARTMENTS AND SECTIONS	
	The Editor's Page 7 The Engineers' Library	28
	Landers in Public Works 18 New Public Works Equipment	114

The 1952 volume of Public Works will be available on microfilm through University Microfilms, 313 N. First St., Ann Arbor, Mich.

THE ENGINEERING AUTHORITY IN THE CITY-COUNTY-STATE FIELD

STRETCHING YOUR HIGHWAY DOLLARS with RUBBER ROADS

Ten countries and seventeen states in the U. S. A. now have test stretches of rubber roads. Massachusetts has over 300 miles of rubber roads. The City of Baltimore last month, after a two-year test, ordered the first routine application of rubber asphalt paving on a city street. One of the most heavily travelled highways in Holland has a stretch of rubber road that has required no maintenance in over 15 years.

These facts are significant to every highway engineer and state and municipal official interested in stretching highway dollars.

Only time and testing will tell how many dollars the addition of natural rubber powder to the asphalt top surfacing of a highway will save. But all the evidence to date indicates that the saving will be substantial.

Would you like to know more about rubber roads?

We suggest three ways.

First, write for a free copy of the 52-page booklet — "Stretching Highway Dollars With Rubber Roads". This booklet gives the whole story on the history of rubber roads, describes in detail the test roads using natural rubber powder that have been laid in the United States and Canada through the 1951 paving season.

Second, ask for a free showing of the new motion picture — "Stretching Highway Dollars With Rubber Roads". Produced by United World, it is a 16 mm., 30-minute sound presentation of the rubber road story to date, including actual showings of test roads, the opinions of the highway engineers who have laid them, and a tour of the Natural Rubber Bureau Research Laboratory, in Rosslyn, reginia

Third, visit the Natural Rubber Bureau's Research Laboratory yourself and see how the effect of rubber powder mixed with asphalt and tar is being studied with the most modern laboratory equipment available.

Rubber roads are the most promising development in highway construction in recent years. If you are interested in pavements with more elasticity, with less susceptibility to temperature variations, less brittleness at low temperatures, and more resistant to shock and vibration — in other words, more wear at less cost — then you will want to know more about rubber roads.

Natural Rubber Bureau 1631 K STREET, N. W., WASHINGTON 6, D. C.

NATURAL RUBBER BUREAU RESEARCH LABORATORY . . . 1101 Lee Highway, Rosslyn, Va.

THE EDITOR'S POINT OF VIEW



Keeping Posted on New Ideas from Overseas

WE Americans take great pride in the part our engineers have played in the material developments of modern civilization. But we should not fail to give credit to engineers of other countries for what they have contributed. In fact, as we look back it seems to us that our special talent has been to recognize a good thing when we saw it and develop it on a practical, efficient and economical basis. The sand filter for purifying water was adopted from England. Practically all our paving ideas came from Europe, from the early corduroy, through macadam, Belgian block, wood block, to asphalt and rubberized asphalt. Probably we can claim credit for introducing the modern concrete pavement, but not concrete itself. Portland cement was made and used in Europe for years before a barrel of it was made in this country. (When the writer began engineering practice, Germany sent portland cement here by the ship load.) We are just beginning to wake up to what Europe is doing in prestressing concrete.

As for sewage treatment, the septic tank came from England; the Imhoff tank from Germany; and the trickling filter from England, where the rotary distributor was used for years before it was adopted in this country. Mechanical aeration was first developed in England (neck and neck in Holland also, we believe). English and American engineers are now running neck-andneck also in their development of new ideas in high-rate filtering and other methods of operating trickling filters.

As said, one of the elements of our progress has been ability to recognize a good thing when we see it, and then go the other fellow one better. And this means looking for new ideas, not waiting for them to come and hit us in the face. Usually the first news about them is found in an item in a technical paper or report, American or foreign. And this is where our "Digests" can help. To find such items, our editors every month look carefully through scores of papers, and technical reports, not only American but also from other countries including England, France, Belgium, Holland, South Africa, Canada, Mexico, and South America. For example, we recently noted experiments in Belgium on treating iron-bearing

water in rapid sand filters; methods used in England for extinguishing fires deep in refuse dumps; studies in the Netherlands of warping stresses in concrete paving slabs due to hourly changes in air temperature; and filtration of sewage through rapid sand filters in England. In addition, there are latest ideas of engineers from California, Texas, Canada, Massachusetts, Alabama—everywhere, in fact. And we mean latest Within two months, usually less, of the time such information appears in print in either this country or Europe, it is noted in the Digests. They offer the easiest and surest way we know of for keeping posted on the latest in Water Supply, Sewerage and Paving of Roads and Airports.

Give the Younger Men a Chance—They May Surprise You

M OST everyone gives lip service to the need and desirability for giving the younger men a chance, but too few apply it personally. We see too many department heads who want to keep everything in their own hands—and heads. They make decisions, often without consulting the younger men who are coming up around them. As a result, the young men under them are not "coming up", and they are not being developed for broader responsibilities. Rather, they are shut off from opportunity for growth, which can come only from being given a voice and a chance. This negative procedure is the first step toward developing a flock of yes-men; and of losing the good men.

When this happens, and an emergency or opportunity occurs, the young men are not ready: they have worked too long in the shadows and they have been dwarfed in their development.

Let these young men have responsibility and even make a few non-fatal mistakes, if necessary, and you gain the big asset of an understudy who will help you do your job better, who can lift many burdens from your shoulders, and who can take on cheerfully larger responsibilities that may occur. Finally, this door to opportunity is rightly regarded as a vital part of the compensation these young men receive. It is their lien on the future, and it is no paving proposition for them or for you to withhold it.





USE TFF INSTITUTE SPECIFICATION UNDERDRAINS

The scientific design of these vitrified clay filter bottom blocks insures trouble-free operation for the life of the filter. They have large top openings. That means proper ventilation of all filter media and free discharge of the filter effluent at all times. They have smooth run-off channels. That means quick drainage and no clogging even with years of operation. The blocks are light in weight, self-aligning and easy for unskilled labor to lay. After they have been laid they are strong enough to work

on and to support even very deep filter media.

These modern underdrain blocks will carry applications up to 50 MGAD. They are best for all kinds and shapes of filters. They are used everywhere better operating results are desired.

Use them to insure best results from your next trickling filter. Give it a specification floor. Use TFFI vitrified clay filter bottom blocks. For full engineering details write any member of this Institute today.





This 166'-0" dia. PFT rotary distributor is one of three in Stockton, Calif. Each is designed to handle a maximum of 12 M.G.D. with recirculation of filter effluent from the underdrains of the filter to the inlet well of the distributor. Arms are 14"

genuine wrought iron pipe. Naturally to go with this excellent PFT equipment the Engineering Office of Clyde C. Kennedy selected a specification floor of Vitrified Clay Filter Bottom Blocks . . . the best kind of filter floor available.

TRICKLING FILTER FLOOR INSTITUTE

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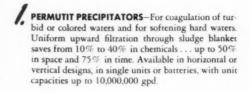
Texas Vitrified Pipe Co. Mineral Wells, Tex. National Fireproofing Co. Pittsburgh 22, Pa. Pomona Terra-Cotta Co

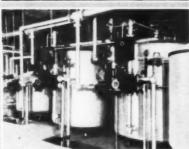
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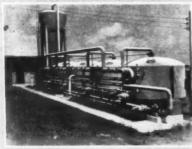
STEPS TO BETTER WATER



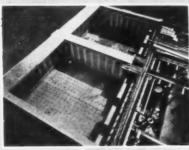




2. PERMUTIT ZEOLITE (Ion Exchanger) WATER SOFTENERS—Simplest method of removing hardness to any required degree. Completely automatic operation assures uninterrupted service and reduces operating costs. Supplied in single units or batteries to fit all requirements.



PERMUTIT SPIRACTORS—New principle—catalytic precipitation—shortens detention time, eliminates sludge disposal, saves steel, floor space. No moving parts. Total reaction time is 8 minutes.

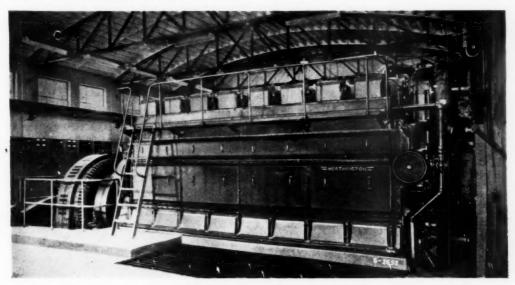


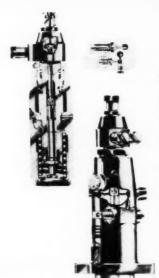
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WATER CONDITIONING HEADQUARTERS FOR 40 YEARS





Worthington-designed dual plunger fuel pump.

This Diesel Is Ready

FOR A CHANGE IN DIET

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When the conversion to gas is made, the dual plunger pumps will furnish pilot oil for ignition. Conversion is made quickly and at low cost.

For any engine application, call on Worthington—an engine for any fuel: oil (crude or regular), gas or "dual fuel". Worthington's complete line of engines assures you of the most economical operation no matter what fuel you use.

Only Worthington dual fuel engines offer such exclusives as dual plunger pumps, gas micro-metering valves for each cylinder, and automatic thermal air control—all built to give optimum performance for the fuel used.

Write for Bulletin S-500-B 31 C, Worthington Corporation, Engine Division, Buffalo, New York.

WORTHINGTON



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Diesel Engines, 150 to 2640 hp Gas Engines, 190 to 2880 hp Dual Fuel Engines, 345 to 2640 hp WORTHINGTON-BUILT AUXILIARIES



Engine Starting



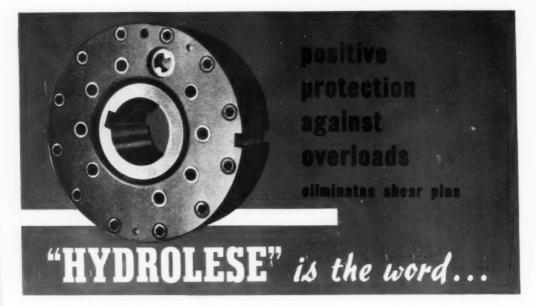
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- . . . adjusted to meet various load conditions
- ... provided with visual warning
- ... readily reset

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Grit Collectors Sludge Collectors Scum Removers Grit Washers Sludge Elevators Screenings Grinders FLOCTROLS Garbage Grinders





How to move a menace A lovely, soft blanket of snow becomes a menace when it shuts in whole communities, blocks off roads, isolates man from his neighbors. When that happens in Minnesota's Wilkin County, Highway Engineer A. E. Chard and his crews swing into action fast. "We're an agricultural county," Engineer Chard explains, "and it's vital we keep our county roadways in good shape."

Four "Caterpillar" No. 12 Motor Graders and four DoMor Snow Blowers take on the worst of storms for the citizens of Wilkin County. The big yellow motor graders plow through and widen out 90 miles of county roads, while the blowers pitch the snow away from the road at the rate of 20 miles per day. Snow and ice are bladed onto the motor grader's snow wing and into the power-driven fans, to be shot far off the shoulder of the road by high-speed rotary blades.

"These snow blowers fill a long-felt need up here where we really have snow," Mr. Chard says. "We're very well sold on them, and on our No. 12 Motor Graders. They've given us consistent and reliable service."

Right now you're preparing for the winter. Your nearby "Caterpillar" Dealer can give you all the details on the DoMor Snow Blower... can show you how it can be attached easily and economically to the versatile No. 12 Motor Grader. Give him a call today.

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TRACTORS & MOTOR GRADERS
TRACTORS & MOTOR GRADERS
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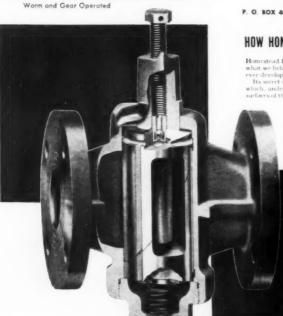
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Add all other plants where F-M engines are used and the total becomes 78%.

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In Kansas—or your state—facts establish the superiority of Fairbanks-Morse diesel and dual-fuel engine performance. Their dependability, economy and low maintenance assure the best in power generation service—at a profit. Fairbanks, Morse & Co., Chicago 5, Illinois.

FROM KANSAS GOVERNMENT JOURNAL



FAIRBANKS-MORSE
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If you are contemplating the installation of water wells or pumps, it will be worth your while to have copies of our water supply or pump catalogs. Write for copies. No obligation.

for this big Phosphate mining operator

Phosphate mining presents many unusual problems, one of which necessitates an ever dependable supply of low cost water. International Minerals & Chemical Corporation, on their big phosphate mining operations near Bartow and Orlando, Florida, are now using nine complete Layne well and pump units. These installations have a total maximum capacity of nearly thirty-thousand gallons of water per minute—enough for greatly increased mining activity.

And so here again we have a case of where water supply failure would stop everything—and where the owner had to be sure that he was buying the utmost in proven dependability, low cost operation and the kind of quality that would assure long life.

But the decision was easy. Layne water supply wells and pumps have an unmatched record of making good on every job no matter how heavy the production, or how long the hours may be. Whether for a mining operation, a city, factory or irrigation farm, Layne wells and pumps always give complete satisfaction and cost less in the long run.

LAYNE & BOWLER, INC.
General Offices, MEMPHIS 8, TENNESSEE

WATER WELLS
VERTICAL TURBINE PUMPS
WATER TREATMENT



... THE NEW **B**-MIXES ALL THE HOT PATCH YOU NEED, ANY TIME, ANYWHERE, ANY WEATHER

Now, the new Barber-Greene Mixall gives you the opportunity to offer high quality bituminous paving for driveways, sidewalks, service stations, industrial plants, parking lots . . . and other "black top" jobs at new low costs.

The Mixall, a completely new, compact and portable small-job maintenance and paying mixer, will produce up to 5 t.p.h. of any type hot mix... up to 10 t.p.h. of cold mix... will produce low slump Portland cement mixes. Built to be towed behind the aggregate truck for on-the-spot mixing, the Mixall is just as well suited for central plant or stock pile operation. The Mixall can work in any weather . . . even drying frozen aggregates.

Think of what you could do with the new B-G Mixall in your territory. Then see the Mixall at your first opportunity . . . or write for full information.

THE ONLY SMALL JOB MAINTENANCE MIXER WITH...

- . ROTARY DRUM DRYING: The same principle used in largest B-G Continuous Dryers.
- TWIN SHAFT HEATED PUGMILL: "Kneading" action assures even coating of every aggregate particle.
- . POWER SKIP HOIST: Only 14" high for easy charging.
- . HIGH DISCHARGE: Can discharge directly into place, into wheelbarrows or gas buggies.











Aurora, Illinois, U.S.A.



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- Choice of Rotary or Centrifugal Capacity matched to the job Easy accessibility Ruggedness
 - Ease of installation Ability to handle overloads Long-time durability Freedom from breakdowns
 - Low maintenance costs Engineering assistance Proved reputation of maker Customer satisfaction

Bettery of four 3-Stage Contribugal Blowers in metropolitan sewage treatment plant. Capacity of each,

15,000 cfm.



You can't afford to take chances when the successful operation of a sewage treatment plant depends upon maintained performance of blowers or gas pumps. So, we suggest that you check carefully the above factors before you make your final decision.

If you are faced with a choice between Centrifugals or Rotary Positives, remember that only Roots-Connersville makes both types. From our exclusive dual-ability line, with capacities from 100 cfm to 100,000 cfm or higher, at moderate pressures, most buyers can find a unit closely matched to their specific needs.

We'd like to remind you, too, that for almost a century we've built only blowers and related equipment. Our products have a long, happy record for outstanding, reliable, economical performance in large and small sewage treatment plants and waterworks. Our vast reservoir of experience is at your service, to meet any problem of handling gas or air.

ROOTS-CONNERSVILLE BLOWER CORPORATION 524 Poplar Avenue, Connersville, Indiana

In the plant illustrated above, three R-C Gas Pumps are used for boosting pressure from gas storage to engines.



DRESSER INDUSTRIE



LEADERS IN THE PUBLIC WORKS FIELD

Warren A. Coolidge, who is Director of Public Works and City Engineer of Nashville, Tenn., has been with the city for the past seven years. Prior to that time he was, for 22 years, professor of civil engineering at Vanderbilt University. During the past four vears he has directed a very large construction and modernization program of public works for Nashville, including the rebuilding of some 250 miles of streets, and the construction of 32 miles of sanitary sewers and 6 miles of storm sewers. This program cost seven million dollars.

He was graduated from the University of Kansas in 1924, with the degree of BS in CE: and in 1938 was awarded an MS degree from Vanderbilt. He is a member of the American Society of Civil Engineers: a member and vice-president of the American Public Works Association: a member and president of the Municipal Division of ARBA: a member of ACI: and a past president of the Nashville Engineering Ass'n.

His hobbies are golf and fishing and he is married (to Elizabeth Cary of Clarksville) and has one daughter.

2,000,000 gallons of

BETTER WATER STORAGE

high above NIAGARA FALLS, N.Y.

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BOOKS IN BRIEF

POLLUTION

This new book covers the practical, theoretical and technical aspects of air pollution. 97 chapters; \$12.50. McGraw-Hill Book Co., 327 West 41st St., New York 36, N. Y.

CEMENT & CONCRETE BIBLIOGRAPHY

This 491-page bibliography contains more than 40,000 references to scientific literature on cement and concrete and covers the period 1925 to 1947. Well indexed and subdivided for easy location of subject matter. \$5. lithoprinted with plastic binding. Director, Engineering Experiment Station, Purdue University, Lafayette, Ind.

HYDRAULIC

The ninth edition of the Standards of the Hydraulic Institute has been published. This contains information on hydraulic pumps and on the frictional resistance to the flow of liquids in pipe. \$3. The Hydraulic Institute, New York.

SOILS ENGINEERING

This book covers the origin, nature and properties of soils and introduces the methods of application of the principles of design and construction which involve the soil, whether foundations, drainage, soil conservation or water control. By M. G. Spangler, \$6.50. Laurel Publishers, Scranton, Pa.

LANDSLIDE

This is not yet an exact science, but it is a subject of importance to highway and other engineers. Three papers discuss various phases of the subject. They are published in Bulletin 49 of the Highway Research Board, 2101 Constitution Ave., N. W., Washington 25, D. C. No charge stated.

FIVE INSTRUCTIVE HIGHWAY BULLETINS

The ARBA has recently published five new technical bulletins covering important phases of highway construction and maintenance. These are: Experimental Use of Lime for Highway Base Courses, By E. Zube, 30 cents; The Value of Welded Wire Fabric in Concrete Slabs, by E. W. Carlton, 25 cents; Looking Ahead

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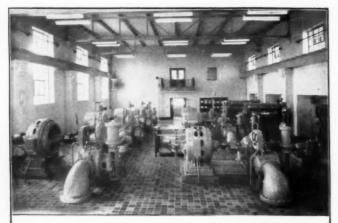
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JOINTS, CRACKS & UNDERSEALS

Bibliography 12 consists of 122 selected annotated references, covering the years 1912-1951, to the problems of preventing infiltration of water, silt, sand, etc., into pavement cracks and joints. Highway Research Board, Washington 25. D. C. No price stated.

FIXTURE SIPHONAGE

This new publication on Self-Siphonage of Fixture Traps was prepared by J. L. French and H. N. Eaton, and is listed as Building Materials & Structures Report 126; 32 pages; 7 tables; 31 figures; 20 cents from Gov't. Ptg. Office.

ACCIDENT PREVENTION

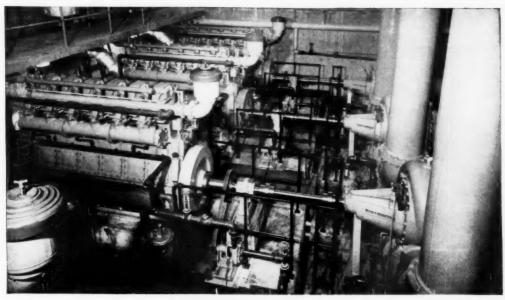
The AGC has issued a series of 14 pocket-sized reprints of some of the sections of its Manual of Accident Prevention. These are 4" by 6". Each section outlines recommended safe practices for one or more operations. Every office should have one set for planning operations, and each workman ought to have one for his type of work. Single copies are 10 cents; more are less. Write Associated General Contractors, Munsey Bldg., Washington 4. D. C., for list of booklets and prices.

HOUSING ORDINANCE

This is a proposed housing ordinance, regulating supplied facilities, maintenance and occupancy of dwellings and dwelling units. It is a guide only, and not a model: but it contains a lot of information, including suggestions for adaptation of the standards to local conditions. American Public Health Ass'n., 1790 Broadway, N. Y. 50 cents.

AIR POLLUTION ABATEMENT

An extensive bibliography, containing more than 1,500 references



FOUR 20-MGD CENTRIFUGAL PUMPS (right) pump raw sewage into Oklahoma City's Southside Sewage Treatment Plant. Worthington Sewage Gas Engines (left) drive pumps. Installation uses three other such pumps for recirculation, also driven by Worthington engines.

An <u>exact</u> match for Oklahoma City's needs

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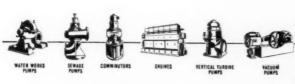
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to literature that has appeared up to Jan., 1952, has been compiled by George F. Jenkins of the Engineering Department, Carbide and Carbon Chemicals Co. Literature is listed under six principal headings. Order from Manufacturing Chemists Ass'n., Inc., Woodward Bldg., Washington 5, D. C. 50 cents.

PLUMBING PROBLEMS

"How to Design and Install Plumbing" may help designing and constructing engineers to do a better job on the often neglected details of this problem. We believe it covers most of the problems that consulting and city engineers will meet in their normal work. Third edition. By A. J. Matthias, Jr., and E. Smith, Sr.; 426 pages; 348 ills. American Technical Society, 848 E. 58th St., Chicago 37, Ill. \$3.95.

MECHANICAL ENGINEERS' HANDBOOK

A 34-year old, used by many thousand, has been revised—Mark's Mechanical Engineers' Handbook. You will find lots of material to help in your daily work. 2,236 pages: over 2,000 illustrations; 800 tables; 12,000-item index. McGraw-Hill Book Co., 330 West 42nd St., New York. \$15.

METHODS OF ROAD

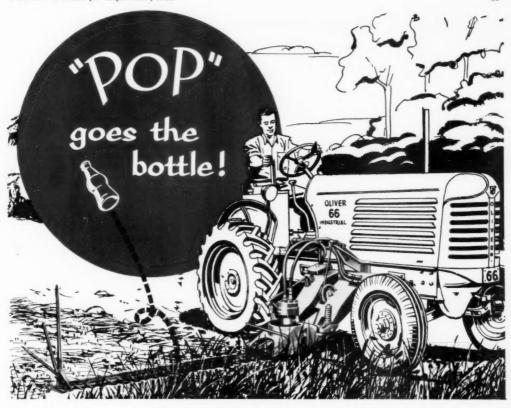
A 24-page booklet gives step-bystep procedure for reclaiming wornout bituminous and gravel roads and also contains actual job cost data and plenty of useful information. Athey Products Corp., 5631 West 65th St., Chicago 38, Ill. No charge.

HIGHWAY OFFICIALS

The ARBA has published a pocket-sized directory of highway officials and engineers. This contains about 1,600 names and lists the personnel of the various states, of DC and of the Bureau of Public Roads. \$1. American Road Builders' Ass'n., International Bldg., Washington 4, D. C.

MECHANICS

"Soil Mechanics for Road Engineers" is a publication of the Dep't. of Scientific & Industrial Research, Charles House, 5-11 Regent St., London SW 1, England. While written with road and airfield requirements principally in mind, it cov-



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FLOW CONTROL NOTES FROM SIMPLEX

Measuring Open Flow of Raw Sewage

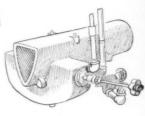
Problem: to measure raw sewage flowing
from a 24" main, under gravity head only,
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ers soils so broadly that it will be widely useful. The chapters on compaction and stabilization are well done. There are 28 chapters containing 318 illustrations and 528 pages. Price is \$6.75 plus 11d for postage, whatever that amounts to.

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A new book that covers both materials and design—how to design prestressed trussed beams, girders and shells—along with a lot of other pertinent information. 261 pages, 153 illustrations. By A. E. Komendant. McGraw-Hill Book Co., New York. \$6.

AIR POLLUTION ABATEMENT

This manual, which is published by the Manufacturing Chemists' Ass'n., Woodward Bldg., Washington 5, D. C., covers sampling methods and equipment. It is the 6th in twelve chapters on the subject. A complete list of publications can be obtained from the Association. This text, 40 pages long, sells for 75 cents.

WATER AND SEWER RATES

The Association of Washington Cities, University of Washington, Seattle 3, Wash., has published two bulletins: No. 143 gives detailed information on the water rates and charges of more than 100 cities in that state; and No. 144 gives similar data on sewer rates for about 70 cities.

ENGINEERING FUNDAMENTALS

This is a new second edition of the "Handbook of Engineering Fundamentals." The editor is Dean O. W. Eshbach of Northwestern Technological Institute. Contributing editors include 39 distinguished scientists. It contains 1,324 pages, covering most of the fields of engineering. John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N. Y. \$10.

TOWN & COUNTRY PLANNING

This is a publication of the British Information Service, 30 Rockefeller Plaza, New York 20, N. Y., and refers to planning in Britain. It contains 32 pages and covers policy making, execution of policy, administration of planning and planning in action, plus a bibliography. Copies free from above address.



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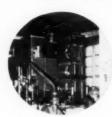
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Completely stress analyzed, constructed of extra heavy '4" steel plate, pre-assembled and match-marked for easy erection in the field, each unit is the product of latest engineering design and fabrication techniquesall combined to produce more efficient, more economical digestion.

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THE CARTER HEAT EXCHANGER is designed to give uniform temperature of tank contents at all times through Carter's exclusive system of jacketed piping and positive temperature control. It will deliver more heat per square inch than any other system of internal piping.

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We Engineered the Mechanical Advantages Of Big Shovels into the Dempster-Diggster





This Dempster-Diggster, shown at work in Creighton, Pa., is also loading hard and stratified material without shooting. It is



The Type GRD, Model 100-HL is shown above loading Hopper Bottom car, height of which is 10'8" from rail to top of car.

Simultaneous Independent Hydraulic Crowding and Hoisting. Variable Crowd Action at Any Dipper Position and Changeable Buckets are engineered into the Dempster-Diggster. Many of the present Dempster-Diggster owners were at one time in the same position you may be in today. They needed front end loaders, but they also needed shovels that could dig out 15 to 18 foot banks. The versatility of the Dempster-Diggster, plus its economical and efficient operation, left them with only one choice. In the first place, the Dempster-Diggster can do anything a conventional front end loader can do-and do it faster and at less cost! Second, on big jobs the Dempster-Diggster is without equal for working in tight places. The Dempster-Diggster is available in either of two types of traction—pneumatic (Type GRD) or crawler (Type CR). Both types are supplied in two models—the Standard (Model 100) or High Lift (Model 100-HL). Our new catalog No. 1032, with over 35 illustrations and complete specifications, shows how this revolutionary shovel can cut your costs tremendously. For your copy fill in the attached coupon and mail today!

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76. A new 20-page booklet in a handy pocket size features Allis-Chalmers complete industrial tractor line. The importance of wise buying and fitting the equipment to the job is emphasized. Don't miss your copy. Use conjon today. Allis-Chalmers Mfg. Co., Tractor Div., Box 512, Milwaukee, Wis.

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Profitable Construction with Payloader

234. A comprehensive, 12-page catalog filled with on-the-job photos showing a wide variety of earth-moving, material-handling, lifting and carrying jobs being performed by the multi-purpose tractor-shovels known as "Payloaders" is now available. Helpful job data specifications and features of the complete Payloader line are included, with illustrations of useful accessories. Copies of this colorful catalog No. 217 can be obtained from The Frank G. Hough Co., 761 Sunnyside Ave., Libertyville, Ill., or by checking the coupon.

POWER AND LIGHT

Gas-Diesel Engines for Low Cost Municipal Power

283. Be sure to get the latest catalogs on Cooper-Bessemer gas-diesel engines for dependable, low cost electric power in your city. Full details are available by writing to the Cooper-Bessemer Corp., Mt. Vernon, Ohio, or just check the handy coupon.

SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay underdrain blocks conforming to ASTM standards, suggestions for layout and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute, Se Editor, N. Y. St. St. New York. St. New York and St. St. New York and Your requestions and we will forward your request. vitrified clay

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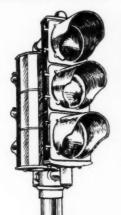


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To order these helpful booklets check the coupon on page 28.

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25. In a helpful 28-page handbook of sewer cleaning methods and equipment the makers of Oh. Champion sewer cleaners give full details of power and hand operated models. Also included are data on expansion buckets that take dirt from sewer to street in one operation, root cutters and other accessories, or of cutters and other accessories, or of the companying of the property of th

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Make Your Own Concrete Pipe For Sewers and Culverts

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High Rate Filters For Sewage Treatment

74. Accelerated biological oxidation in treatment of sewage and other organic wastes

is a feature of Infilco's Accelo Filter system. Bulletin 6200 explains the direct recirculation principle, shows plant layouts, and gives performance data. For your copy write Infilcoupon.

Box 5033, Tucson, Ariz., or check handy coupon.

Helpful Design Data For Sewage Ejectors

81. The applications and advantages of pneumatic sewage ejectors are outlined in a new bulletin of the Blackburn Smith Mfg. Co., Inc., Hoboken, N. J. Included are piping diagrams for electrode and float switch control plus dimensions and layouts for single and duplex aystems. Get your copy by checking cou-

Using Sewage Sludge Gas For Power Generation

90. Fairbanks-Morse dual fuel engines can operate on either sludge gas or oil to provide steady power output despite fluctuations in gas supply. Bulletins are available on several sizes to meet your needs. Write, giving exact requirements to Fairbanks, Morse & Co., Dept. PW, 600 So. Michigan Ave., Chicago 5, Ill.

Get the Facts on

The Contact Aeration Process

94. Full engineering details on the submerged contact aeration process of sewage treatment, including diagrams of plant units, area requirements, operating costs and other details are available in a bulletin of the Hays Process Co., Box 768, Waco, Texas. Check the coupon to get the facts.

Designing Grit Chambers? Here's What You Should Know

113. A helpful bulletin filled with dravings of typical designs, operating data, clearly written text outlining the principles of grit clamber design and requirements for removal of grit free from oganics is offered by the Dorr Company. Get your copy of Bulletin 6411 on the Dorr "Detrior" by checking the coupon or from The Dorr Co., Barry Pl., Stamford, Conn.

End Root Problems

With Root-Proof Sewers

107. Troubles caused by roots and corrosions in house connections can be eliminated by the use of root-proof Bermico sewer pipe. Full details on this smooth, waterproof, tight-scaing pipe available by checking the coupon, or write to the Brown Co. Dept. PW, 150 Causeway St., Boston 14, Mass.

Non-Clogging Vertical Wet-Pit Pump Described

182. Full engineering data on Worthington "Freefio" wet-pit pumps with non-clogging impellers capable of passing solids and stringy material are included in Bulletin W-317-B12. Check these pumps for sump, sewage and drained to the component of the property of the component of the property of the property of the coupon.

Design Data for Insulated Piping

188. For all jobs where insulated piping is required you will want full design data on Ric-wil Prefabricated Insulated Piping. Get 28-page catalog from the Ric-wil Co., Cleveland, Ohio. for details on both underground and overhead lines.

How Vacuum Filters Help Your Sewage Sludge Disposal

209. Applications of the Conkey sludge filter to all types of sewage sludge are described in Bulletin 100. Tables show filter sizes, weights, and give anticipated average results. Use the coupon to order your copy. General American Transportation Corp., Process Equip. Div., New York 17, N. Y.

How to Dispose of Sewage and Industrial Sludges

281. Get full information on the C. E. Raymond System of combined incineration and sludge drying providing high temperature de-odorzing for nuisance-free sludge disposal Flexible layouts fit large and small communities. Use handy coupon or write Combustion Engineerine-Superheater, Inc., Flash Dryer Div., 200 Madison Ave., New York 16, N. Y



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The Midget, 1½" - wgt. 62 lbs., 5500 g.p.h. Primes in 75 sec. at 25 ft. suction lift. The Pelican, 2" - wgt. 70 lbs., 7500 g.p.h. Primes in 75 sec. at 25 ft. suction lift. The Hawk, 2" - wgt. 110 lbs., 10,000 g.p.h. Primes in 47 sec. at 25 ft. suction lift. The Eagle, 3" - wgt. 117 lbs., 18,000 g.p.h. Primes in 79 sec. at 25 ft. suction lift.



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on the engine shaft and operates at engine speed.

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Complete Catalog for Engineers Shows Water and Sewage Plant Equipment

191. The complete line of Jeffrey equipment for treatment of water, sewage and industrial wastes is covered in \$2-page Catalog 833. Detailed information is provided on bar screens, grinders, grit collectors, "jigrit" washers, sludge collectors, feeders, conveyors and other related units. Photos and drawings of installations plus capacity tables complete this valuable booklet. Use coupon or write leftrey Mfg. Co., 947 N. 4th St., Columbus 16. Ohio.

Efficient Blowers for Activated Sludge Plants

232. Many advantages of Roots-Connersville positive displacement rotary blowers are described in Bulletin 22-23-B-13, which also provides characteristic curves for operation with constant speed, multi-speed and variable speed motors and details of several types of blowers. Get this helpful bulletin by checking the coupon. Roots-Connersville Blower Corp., Connersville, Ind.

Valuable Booklet on Porous Diffuser Plates and Tubes

21. A belgful 20-page booklet published by the Norton Co. is a complete guide for the selection of porous media for installation in activated sludge plants. Full data for the designing engineer is provided by careful detailing Maintenance of porous media also is discussed at some length. For your copy of Form 1246, write to the Norton Co., Dept. PW, Worcester 6, Mass., or use the coupon.

Construction and Engineering Service For Water and Waste Systems

77. In addition to their nationally-known water and sewer system rehabilitation services, the Pittsburgh Pipe Cleaner Co., 133 Dahlem St., Pittsburgh 6, Pa., is now prepared to furnish complete engineering and construction service, including surveys, tests, design and these services will be found in an attaction of these services will be found in an attaction ended to the services will be found in an attaction of these services will be found in an attaction of the services.

SPARKLER MANUFACTURING CO. MUNICILLIN, ILL.

Sound Film Shows Sewer Cleaning During 1951 Flood Disaster

250. A sound film tracing the work done during the disastrous 1951 flood in Kansas City by Ace Pipe Cleaning Contractors, Inc., 2003 Indiana, Kansas City, Mo., is available to city officials without charge. Check the coupon for full details on how you can secure this professionally prepared film showing complicated sewer main cleaning operations.

REFUSE COLLECTION AND DISPOSAL

How Load-Packers Reduce Refuse Collection Costs

123. The sequence of operation for fast loading and refuse compression in the Gar Wood "Load-Packer" is illustrated and described in 8-page folder M 60, which also provides size data and details of hydraulic equipment. Be sure to check all features of the efficient Load-Packer system. Check coupon or write Gar Wood Industries, Wayne Div., Wayne, Mich.

Efficient Material Handling to Reduce Incineration Costs

130. Blaw-Knox Buckets specially designed for refuse and garbage handling are described in 22-page Bulletin 2350. Illustrations show progress of material through a modern municipal incinerator plant. Dimensions and incinerator bucket specifications are included. Blaw-Knox Div., 2124 Farmers Bank Bldg., Pittaburgh 22, Pa.

Thinking of Sanitary Landfills? Get This Booklet Now

131. One of the most informative descriptions of the sanitary landfill method of garbage and refuse disposal is presented in Caterpillar's 16-page booklet "A Look to the Future with Sanitary Landfill." The booklet is designed to serve as a guide to proper site selections, the choice of the right equipment to do the job, and the actual operations of sanitary fill. Pictorial treatment shows how and when to start such a program, what to look for in a site, benefits received by the community, and other important considerations. Published by the Caterpillar Tractor Co., Peoria 8, Ill. Check the coupon for your copy.

Increasing the Efficiency of Bulk Rubbish Collection

177. Strategically spotted bulk containers can be handled by one man operating a Demyster-Dumpster equipped truck. Get full details of this cost-saving system of rubbish collection, as used by many cities to increase efficiency and eliminate unsanitary conditions. Write Demyster Brothers, Inc., 952 Demyster Bldg., Knoxville 17, Tenn., or use the handy coupon.

CIVIL DEFENSE

Check Your Power Needs Without Delay

48. International Harvester Company has available a new folder describing its line of diesel engines and power units for all your power needs up to 180 hp. For a copy of this colorful booklet, write to International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill., and ask for Form A-156-NN, or use the handy coupon and we will forward your request.

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305. Vital for emergencies and indispensable labor savers for routine tree maintenance and other jobs, chain saws are needed by every feet information now on light form McCalloch Motors Corp., 610 W. Century Blvd., Los Angeles 45, Calif. Check the coupon today.

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FLOORS, DRIVES, RUNWAYS EASILY CUT FOR REPAIRS— Rail tunnels, rail and pipe trenches, air lines and machinery bases were cut in dense concrete with a Model C-130 Clipper Concrete Saw and CDS-20 Diamond Blade at the rate of 5' per minute—3" deep. Tremendous savings were claimed by the contractor in removal and replace ment.-Write Clipper Mfg. Co., 2823 E. Warwick, Kansas City 8, Mo.



TRACK SAW NOW CUTS LARGEST STONE, TRANSITE, TERRA COTTA — By placing C-15 Clipper Concrete Saw on tracks, a Cleveland contractor cut limestone veneer units from 15'x7"x15" quarry lengths. In addition to large, bulky shapes this model is efficient and dustless for inside patch and trench work.—Write Clipper Mfg. Co., 2823 E. Warwick, Kansas City 8, Mo.



CONTRACTION JOINTS NOW SAWED-Floors, walks, drives and runways now poured continuously (reduces bulkheading!) Then joints are sawed to eliminate hand forming and costly spalling—Clipper
Mfg. Co., 2823 E. Warwick, Kansas City 8, Mo.

STUDIES OF SAWED JOINTS PROVE VIRTUAL ELIMINATION OF SPALLING - Highway transverse joints sawed 2" deep are devoid of spalling after 1½ years in contrast to heavy spalling in a few weeks on formed joints, according to State tests.







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Excellent Booklet Shows Aerial Mapping Technique

77. A clear explanation of the technique of aerial topographic map production is given in "Air Speeds Your Map Needs." Striking photographs trace aerial photos step-by-step to the gional zoning and planning, traffic studies, drainage and watershed projects, tax maps and many other types of work. Use the coupon to get this excellent booket for public works and planning officials. Jack Ammann. Photogrammetric Engineers, 829 N. St. Mary's St., San Antonio 2, Texas.

Your Dump Truck As a Complete Working Unit

39. The addition of a Holmes-Owen Loader to four dump truck converts it into a complete digging and loading unit that enables one man to load, haul and dump. Illustrated folder shows how this self-loading unit with hydraulic crowding action can be a real time and labor saver for the municipality or contractor. Check the handy coupon for full data. Ernest Holmes Co., Chattanooga, Tenn.

Do You Have Complete Black Top Equipment Data?

41. In 36-page catalog AA a full line of maintenance is covered. Units described and illustrated include several models of pressure distributors, supply tanks, sprayers, brooms, asphalt kettles, portable rollers, and accessory tools. Use coupon for copy of this handy manual. Littleford Bros., 452 E. Pearl St., Cincinnat 2, Ohio.

Aerial Surveys and Maps from Photographs

53. Written in non-technical language, a 16-page booklet with this title gives a complete explanation of aerial surveys for the municipal field. Interesting step-by-step pictures show how planimetric and topographic maps, mosaics and atlas sheets are produced by Abrams Aerial Survey Corp., Lansing 1, Mich. Check the coupon for your copy.

3 to 5 Ton Tandem Roller Has Many Uses

B4. The Calion Iron Works & Mfg. Co., Calion, Ohio, has just issued a catalog on their new model 3-5 ton Variable Weight Tandem Koller. The many improvements in construction and operation are fully described and illustrated. Get your copy of Catalog 360 by checking the coupon.

Concrete Saw Cuts Smooth, Straight Edges

85. When the sides of patches and trenches are sawed before breaking, a saving of 25% in removal coats is claimed. And the smooth, straight edges won't spall or crack after replacement material is poured. Investigate the exclusive features that give maximum economy to Clipper concrete saws. \$2 all S. Warwick, Kansas City 5, Mo., or check the handy coupon.

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297. With the Barber-Greene Mixall you can get hot patch material wherever and whenever you need it for all maintenance jobs. Send for new 8-page bulletin that gives full information on this small, highly portable unit that turns out all types of hituminous patch material in any quantity you need. Write Barber-Greene Co., Aurora, Ili, or use the coupon.

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98. Quick, efficient cuts in pavement for repair and installation of underground utilities are sufficient cuts in pavement for repair and installation of underground utilities are sufficient to the sufficient of the sufficient to the sufficient t

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96. You'll like every feature of the Austin-Western 99H Grader. It has all-wheel drive, all-wheel steer, controlled traction, precision sideshift and a high lift, extreme reach, reversible blade. Get data from Austin-Western Co., Aurora, III.

What's Your Traffic Problem?

127. Traffic signals and controllers of every type are offered by Eagle Signal Corp., Moline, III. You will find a great deal of help-ful data and diagrams of typical installations in Bulletins A 10 and C 10, available by checking the coupon

Black-Top Paver Offers Many Advantages

156. The flexible Adnun Black Top Paver lays any asphalt mix, hot or cold, in widths from 6 ft. to 13 ft. Careful design lowers operating cost and cuts maintenance. Attachments spread stone, cinders or slag. Get full data on this machine by checking coupon. The Foote Co., 1954 State St., Xunda, X. Y.

Your Property is Worth Good Protection

176. When installing link fence you want protection against rust and corrosion as well as vandalism. Investigate chain link fence made of "Konik" metal described in "Flanned Protection" published by Continental Steel Corp., Rokoton, Ind.

Valuable Booklet Tells Soil Stabilization Facts

206. All forms of soil stabilization, using any type of binder with any suitable aggregate, are covered in "Soil Stabilization Methods," Bulletin 25 published by Seaman Motors, Inc., Milwauke 3, Wis. Get this valuable booklet for complete information on processing methods and the many uses of the Seaman Pulvi-Mixer by checking the coupon.

Snow Plows for Every Street and Highway Need

227. In a new bulletin, No. 51-F, full details are given on the Frink reversible trip-blade "Sno-Plow", which has special design features to eliminate chatter and to permit quick adjustment to nine plowing positions or scraping for your copy. Frink Sno-Plows, Inc., Clayton, N. Y.

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279. The lightweight, power driven Sythette cuts smoothly in rocky, hard-to-reach places; does the job 4 times faster than ordinary methods. Illustrated folder offered by Hoffco, Inc., Richmond, Ind. Get your copy by using coupon.

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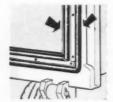
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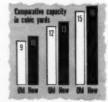
S. New LEAKPROOF TAILGATE SEAL AND LOCK eliminates seepage of residual liquids pressed from refuse compacted into body. Seal is of double-contact tubular type for meximum efficiency and long life.



6. New, TAPERED BODY DESIGN with smooth interior surface assures fast, complete lead discharge -prevents load hanging within body. Clean-lined exterior cannot catch on low-hanging trees.



7. New LARGER RIDING STEPS, conveniently located on each side of body, provide increased standing area for greater safety. Steps are low-mounted for greatest convenience and accessibility.



8. New. INCREASED LOAD CAPACI-TIES, made possible by Gar Wood advanced engineering, mean larger loads per trip and fewer trips to point of disposal—resulting in substantially-reduced operating costs.



Here's another first added to Gar Wood's long list of engineering achievements-the new, 1953 Gar Wood LOAD-PACKER.

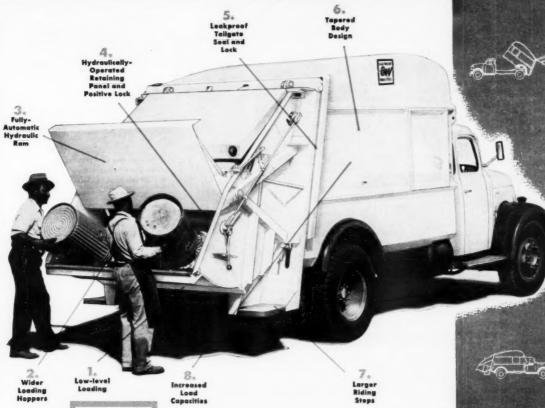
More than 30 design and engineering improvements add up to faster refuse collection schedules and lower operating costs. Increased capacity means fewer trips to disposal point. Improved, direct-line ram actuation exerts greater compacting force . . . insures denser compaction of refuse and extra capacity per cubic content of body.

And, since body and hoist are a "Packaged Unit," installation costs are reduced as much as \$150.00 under average conditions. Changing LOAD-PACKER body from one chassis to another is also simplified.

Find out today why more than 2,000 American cities use and prefer Gar Wood LOAD-PACKERS-why Gar Wood LOAD-PACKERS are the 4-to-1 choice of public officials everywhere.

Collection For Your Community

LOAD-PACKER



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TRUCK EQUIPMENT: Dump Truck Bodies & Hoists, Winches & Cranes, Refuse Collection Bodies, Elevating End-Gates. CON-STRUCTION EQUIPMENT: Excavators, Scrapers, Dozers, Ditchers Spreaders, Finegraders, Truck-Mounted Road Graders.

Fill out and mail this coupon now for complete facts about how you can cut your refuse collection costs with the new, 1953 Ger Wood LOAD-PACKER. Gar Wood Industries, Inc. 36102 Main St., Wayne, Mich. Attn. Customer Service Dept.

Please send me complete information about the new, 1953 Gar Wood LOAD-PACKER.

Name_____Position____

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STREETS & HIGHWAYS (Cont.)

Two-Way Radio Equipment For All Departments

293. The benefits of two-way radio communication in the uncongested non-interference 450-megacycle range make full information on this subject important to all engineers. Get full data on trouble-free systems from Motorola, Inc., Dept. PW, 4545 Augusta Blvd., Chicago 51, Ill. Just check the coupon.

Latest Data on Rubber Roads

296. A new report covering all developments to date on the use of natural rubber in road surfacing of asphalt highways has been issued by the Natural Rubber Burcan, 1631 K St. N. W., Washington 6, D. C. Get your copy of this 52-page booklet which includes new data or research and full reports on test roads in many states. Use the handy coupon.

Hot or Cold Patching Mixtures Prepared on the Job

304. By preparing your patching mixtures, hot or cold, right on the job, you can use them immediately with a minimum of handling. Get full data on the McConnaughay Model HTD "Multi-Fug" Asphalt Mixer for fast, easy and economical preparation of patch materials. Write K. E. McConnaughay, Lafayette, Ind. or use the coupon.

Versatile Road Wideners Improve Highways at Low Cost

306. In a new bulletin the full line of Apsco wideners, base pavers, bituminous paver finishers, widening chippers and tandem rollers is described and profusely illustrated. Versatile wideners can handle stone, concrete or bituminous mix, all without forms. Be sure to investigate this easy way to modernize your high-ways. Get full data from All Purpose Spreader Co., Elyria, Ohio, by checking the coupon.

WATER WORKS

Here's How To Handle Those Bulk Chemicals

22. Chemicals purchased in bulk reduce treatment costs but present a handling problem. Now, with the Link-Bell Bulk-Flo feeder, conveyor and elevator combined in one compact fully enclosed assembly, your problem can be solved. Book No. 2475 has 28 pages showing installations, size selection, layouts and full engineering data for all combinations of horizontal, vertical and inclined movement of chemicals. Get your copy by using the coupon. Link-Belt Co., 307 N. Michigan Ave., Chicago 9, Ill.

How to Keep Trenching Jobs on Schedule

24. The easy mancuverability of the tough, compact Cleveland Model 95 "Baby Dive ger" makes it well suited for the difficult job of trenching past the many obstacles of city and suburban work. Multiple digging and crawler speeds handle all soil types and trench widths up to 24" Get Bulletin 5-32 from Crewland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio.

Is Your City Metered 100%?

33. 100% metering as practiced by many cities requires accurate, dependable meters with interchangeable parts. Cut-away views of every part, capacity and size data are all included in handsome American-Nigara water meter booklet available from Buffalo Meter Co., 2920 Main St., Buffalo 14, N. Y.

Seven Advantages of Prestressed Concrete Steel-Cylinder Pipe

43. All the things you want in water supply lines: permanency, structural strength, high carrying capacity, easy tapping, design flexibility, easy installation and economy are claimed for Frestressed Concrete Steel-Cylinder Pipe made by Price Brothers Co., 1932 East Ilonument Ave., Dayton 1, Ohio. Get full details by checking the coupon.

Quick Way to Locate Leaks and Pipe

57. The Globe line of leak locaters, dipping needles and pipe finders, Geophone leak locator. Little Wonder pipe phone, and the Magnetic Dipping Needlle, described in several leadiess, Mobe Phone Mig. Corp., Dept. P., Reading, Mass.

Specifications for Jointing Reinforced Concrete Pipe

63. Engineering specifications for use of the sexual rubber gaskets with reinforced concrete sewer pipe are contained in a new brochure published by Universal Concrete Pipe Co., Dept. PW, 297 S. High St., Columbus, Ohio, Subjects include dimensions, pipe design reinforcement, curing and jointing instructions. Get your copy by checking the coupon.

Efficient Coagulation With Ferri-Floc

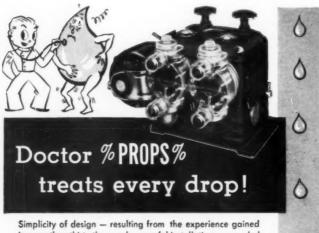
69. Advantages claimed for Ferri-Floc as a cagallant include wide pH range, quick floc formation, manganese removal, control of certain tastes and odors, plus other aids in high quality water production. Check coupon for complete Ferri-Floc data. Tennessee Corp., Grant Biog., Atlanta, Se.

96 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH control and description of comparators, chlorimeters and similar devices. A 96 page booklet. W. A. Taylor & Co., 7304 York Road. Baltimore 4, Md.

Reference Catalog for Valves, Fittings and Hydrants

72. A complete line of gate valves for all services, standard flanged and screwed fittings, and the Kennedy "Safetop" fire hydrants are fully described in Catalog 63 of The Kennedy Valve Mig. Co. Elimin, N. Y. All engineers who specify valves, fittings and hydrants should have this valuable catalog for ready reference. Check the coupon.



Simplicity of design — resulting from the experience gained in more than thirty thousand successful installations — coupled with sound engineering practice has produced %Proportioneers% low cost, easy to install and operate Chemical Feeder. Thousands are accurately and dependably delivering water treating chemicals in almost every country in the world.

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%Proportioneers, Inc.% offers you the opportunity of obtaining years of highest accuracy chemical feeding at lowest cost. Write for Bulletin SAN-7. %Proportioneers, Inc.%, 356 Harris Avenue, Providence 1, Rhode Island.





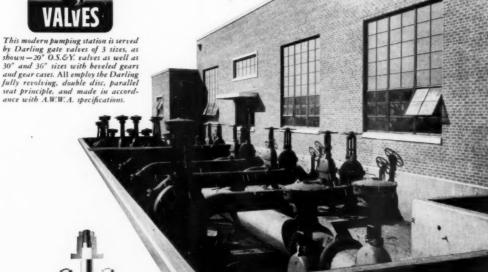
Note rugged simplicity of this unique

Darling principle-just four sturdy working parts . . . two plain inter-

changeable no-pocket discs and two

busky wedges. Assembly and maintenance is extremely easy and foolproof.

FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN



Time and money ahead

THIS new municipal pumping station gains a unique advantage proved in hundreds of similar operations throughout the country. Because these gate valves are Darlings... featuring Darling's fully revolving, double disc, parallel seat principle... the city as well as the water department will be time and money ahead years on end.

If you haven't yet checked into Darling gate valves of this type (shown in cutaway view at left) we'd like to give you all the facts on the distinctive features that always add up to . . .

1. Positive, easier closing. 2. Automatic adjustment for valve body distortion. 3. Elimination of disc-to-seat galling. 4. Uniform wear distribution. 5. Greater service life with far less maintenance.

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Darling's latest bulletin is full of helpful information and describes Darling valves of *all* types for every normal or unusual service.

DARLING VALVE & MANUFACTURING CO. Williamsport 22, Pa.

Manufactured in Canada by The Canada Valve & Hydrant Co., Ltd., Brantford 7, Ont.

To order these helpful booklets check the coupon on page 28.

WATER WORKS (Cont.)

Cement Lining for Smaller Diameter Water Lines

89. Water lines from 4" to 12" diameter are now cement-lined in place by Centriline Corp., using the Tate process. Catalog C50 tells how this operation gives new pipe performance to old lines, and shows just how the work is done. An interesting folder, well worth studying. Check coupon for your copy. Centriline Corp., 140 Cedar St., New York o, N. V.

How Accurate Boring Speeds Underground Pipe Installations

135. Interesting charts showing earth buring costs, speed and accuracy for holes from
2½" to 14½" diameter and up to 80 feet long
are included in 16-page Catalog No. 8 resused
by Hydrauger Corp., 081 Market St., San
Francisco 5, Calif. Specifications and general
operating instructions are also covered.

Pipe Detector Determines Exact Location and Depth

126. Determination of the exact location and depth of buried pipes, valvea, service cables and other metallic objects can save costly digging and unnecessary damage. Your work can be speeded when you use the Detectron pipe detector, which features simple operation, shielding to avoid static interference, economical unit construction and a lifetime guarantee. Get full data from Detectron Co., 5631 Cahuenga Blyd., No. Hollywood, Calif., by using the coupon.

How to Tap Concrete Pressure Pipe

124. The simple steps required in making a pressure tap in concrete pressure pipe are explained in a booklet issued by Lock Joint Pipe Company. Be sure you know how either large connections or small service outlets may be made economically and without ascrifice of strength. Just check the handy coupon. Lock Point Pipe Co., Box 269, East Orange, N. J

Helpful Data on Mechanical Joints

138. Get Circular 49 from M & H Valve & Fittings Co. for important information and installation dimensions of M & H AWWA Mechanical Joint Valves and Hydrants. Features include ease of installation, construction economy, long life. Use coupon or write M & H Valve & Fittings Co., Anniston, Ala.

How Your Filter Washing

Can Be Improved

136. More thorough sand washing with the elimination of mud balls and cracking with resultant longer filter runs are claimed for the Palmer Filter Bed Agitator, described in bulletins issued by the Palmer Filter Equipment Co., P. O. Box 1655, Erie, Pa.

Pollution-Proof Outdoor

Drinking Fountain

144. A new outdoor drinking fountain so designed that contamination by cross connections or back siphonage is not possible is fully described in a 4-page bulletin. Features neat appearance, easy installation. Write Murdock Mig. & Supply Co., 426 Plum St., Cincinnati 2, Ohio, or use coupon.

Helpful Book Gives Pipe Flow

159. This handy 40-page pocket size book titled "Measurement of Water Flow Through Pipe Orifice with Free Discharge" explains the Layne pipe orifice meter method of computing water flow, Includes flow graphs for various size pipes. Layne & Bowler, Inc., Box 215, Hollywood Station, Memphis 8, Tenn.

What You Should Know About Meter Setting and Testing Equipment

164. Complete details on all equipment and proper methods for meter testing and installation are included in an excellent book published by Ford Meter Box Co., Wahash, Ind. All waterworks men concerned with setting and testing of water meters should have a copy of this book. Write for Catalog No. 50.

Be Sure To Investigate The Be-Ge Trencher

171. Municipalities and contractors both report that the Be-Ge trencher, with its fully hydraulic operation and easy maneuverability, cuts costs and brings profits on all types of trenching jobs "Hydratans" fluid motor delivers smooth, positive power at any creep speed. Dies up to 24" wide and 5 ft. deep. Hydraulically controlled backfiller blade is standard equipment. Get form 520 from Be-Ge Mig. Co., Gilroy, Calif., by checking the handy coupon.

Handy Calculator for Cast Iron Pipe

175. With the handy Cast Iron Pipe Calculator you can determine at a glance the class, weight and dimensions of bell and spigot pipe. This slide-rule type calculator is absolutely free. Use coupon or write R. D. Wood Company, Public Ledger Bldg., Philadelphia 5, Pa.

Locate Mains and Services Without Digging

186. A 16-page booklet tells how to use the Fisher "M-Scope" to locate buried pipes and valves by electronic means. Proper manipulation also determines depth of cover. Battery operated unit is readily carried by one man. Get data from Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif.

What You Should Know About Design of Gravity Filters

190. Complete design data on gravity filters and details of all filter accessories will be found in a comprehensive 24-rage booklet prepared by the Fermutit Co., 330 West 42nd St., New water problems should magner dealing with authoritative reference. Check the coupon for this authoritative reference. Check the coupon for

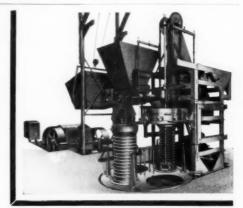
Installation Guide for Transite Pressure Pipe

192. A convenient, pocket-size book of 115 pages covers the whole job from receiving and handling pipe to pressure and leakage tests of finished lines. Over 100 drawings show important operations, and the text tells both how and why. Copies are available from Johns-Mariville, Dept. PW, 22 E. 40th St., New York 16, N. Y.

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- 1) Doubles production in all sizes 4" to 36".
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- More resales you can't sell a lemon to the same man twice.

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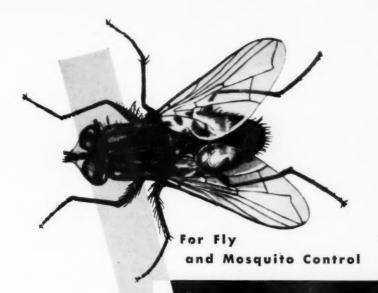


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To order these helpful booklets check the coupon on page 28.

Technical Service Offers Help on Fluoridation Planning

207. Helpful information to assist in paraming new installations and improvement of existing fluoridation systems is available from General Chemical Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y. Check the handy coupon today.

Chloringtion for

Large and Small Pools

210. Dependable chlorination is a necessity for all swimming pools, no matter how large or small. You can find out just how to protect your pool in the most dependable and economical way by using the coupon or writing Wallace & Tiernan Co., Inc., Box 178, Newark 1, N. 2.

Does Your Water Works Have Standby Power?

224. Dependable Climax power plants are ready for emergency service to insure fire protection, and can also save power costs by peak load operation. Use the coupon for full data on Climax, 40 to 495 IIP, operating on sewage or natural gas, butane or gasoline. Climax Engine & Pump Mig. Co., 208 So. La Salle St., Chicago 3, Ill.

Helpful Data on Main Sterilization

231. This detailed discussion of main and emergency sterilization indicates standard procedure, shows how to calculate quantities of sterilizing solution, describes equipment and gives typical specifications. All calculations can be solved by use of a simple chart. Use coupon to get your copy of Bulletin SM-9365. Proportioneers, Inc., 356 Harris Ave., Providence 1, R. 1.

Helpful Valve Catalog For Engineers

236. For complete descriptions of Darling double disc, parallel seat gate valves be sure to get Bulletin 5002 issued by Darling Valve & Mig. Co., Williamsport, Pa. Construction details covering all valve parts and accessories are helpful for specification writers. Check the coupon for your copy.

How to Make

Fluoride Determinations

244. Information on the Hellige Aqua Tester for precise fluoridation control in the range from 0 to 1.6 ppm fluoride is available from Hellige, Inc., 877 Stewart Ave., Garden City, L. L., N. V., by using coupon.

Book Tells How to **Control Root Stoppages**

249. Details on the proven use of copper sulfate to control root and fungous growths in sewers are contained in a brand-new book pub-lished by Phelps Dodge Refining Co., 40 Wall St., New York S, N. Y.

Attractive Bulletin Features Large Elevated Tanks

252. In a new 24-page booklet, "Horton Elevated Steel Tanks of Large Capacity," Chicago Bridge & Iron Co, Chicago A. Ill., describes the advantages of using large elevated steel tanks to provide gravity pressure in municipal water systems. Detailed information on radial-cone tanks of 500,000 to 3,000,000 gal, is included in this really bandsome bulletin. Check coupon for your copy.

General Catalog on Measuring and Controlling Equipment

272. The full line of Simplex equipment for the measurement and control of liquids and gases in water and sewage plant installations is illustrated and described in detail in 28-page Catalog 1002. Every engineer should study the design data in this helpful booklet. Write Simplex Valve & Meter Co., 68th & Uplands Sts., Philadelphia 42, Pa., or use the cutton.

Gauges for Good Filter Plant Operation

275. Mechanically operated filter gauges for indicating and recording loss of head, rate of flow, sand expansion and other data needed

for good filter plant operation, are described in Bulletin No. 450-H10, issued by Builders-Providence, 356 Harris Ave., Providence 1, R. I. Besides details on the gauges themselves, typical installations are shown. Check coupon

Corrosion Protection

For Water Works

280. Steel pipe lines, elevated tanks, treatment plant equipment and all other steel structures subject to rust, tuberculation and attack by aggressive soils can be protected by long-lasting Bitumastic enamels. Send for bulletins today so that you can specify the right coating for your job. Use coupon or write Koppers Co., Tar Products Div., Dept. 25ST, Pittsburgh

Factors to Consider in **Elevated Tank Selection**

299. Details on the several different types of elevated steel tanks, including capacity ranges, tank dimensions and other factors to be considered in the selection of elevated tanks for modern water storage, plus discussions of new tanks for old towers and foundations are included in Bulletin [01] of the Pittsburgh-Des Moines Steel Co., Neville Island, Pittsburgh, Pa. Check compon for your copy.

Job Data Offered on New Steel Water Lines

300. A 12-page illustrated report listing construction details on steel water lines is entitled "A Report on Dresser-Coupled Steel Water Lines in the Year 1951". Get your copy from Dresser Mfg. Div., 39 Fisher Ave., Bradford, Fa. by checking the coupon.

Cleaning Service for Every Type of Pipe Line

302. Flexible Pipe Cleaning Co., operating with specialized equipment and trained crews, is prepared to remove scale, rust and other deposits from pipes for every type of service. For details and estimates furnished without obligation write Flexible Pipe Cleaning Co., Box 167, Los Nictos, Calif, or cheek the coupon.



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When people are counting on you to meet vital construction schedules . . . you've got to have material from a convenient source. Universal has a reputation for delivering material which is right the first time . . . plus the equipment and facilities to give you concrete pipe when you need it . . . where you need it. 23 major plants, located in primary building areas, gives you a source of supply where you want it!

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opton, Port Washington, Rechester and Syrocuse, N. T. Columbus and Zanesville, Ohio: Norristown and Pittsburgh, Pa.; Nashville, Tenn.; Clarksburg, New Martinsville and Wheeling, W. Ya. UNIVERSAL AFFILIATES—Concrete Pipe Co. of Ohio with plants in Cleveland, Youngstown and Sandusky, Ohio and Erie, Pa.; Florida Consrete Pipe Co... Osala, Fla.; Dixie Concrete Pipe Co., Louisville, Ky.

SEE OUR EXHIBIT - SEWAGE WORKS & INDUSTRIAL WASTES ASSOCS. - OCT. 6-9 - NEW YORK CITY



Washington Water Power Co.'s Clarkston filtration plant gets water from 19,000,000 gal. reservoir. Consulting engineer: W. L. Malony, Spokane, Wash.

LINK-BELT supplies major equipment for Clarkston, Wash., filtration, sewage plants

CITIZENS of Clarkston, Wash., received a healthy boost in sanitary services recently. Their new water filtration plant, equipped with Link-Belt mixers and collectors, purifies water at an average rate of 3 mgd. In addition, major equipment in the new sewage plant was also built by Link-Belt.

The Link-Belt collectors of the Straightline type and Link-Belt mixers provide optimum floculation and maximum sludge collection and removal in the shortest time. Economical operation is assured at all flow conditions. Whether your requirements are large or small, our sanitary engineers will be glad to work with your engineers, chemists and consultants—help you get the best in modern water, sewage or industrial liquids treatment.

At Clarkston's new sewage treatment plant, two Link-Belt Straightline Sludge Collectors, plus a mechanically cleaned bar screen, efficiently remove the solids from the sewage. Consulting engineer: R. H. Corey, Portland, Ore.





Link-Belt flash mixer (background) and slow mixer are driven through Link-Belt worm gear and motorized P.I.V. variable speed drive with Class 700 Pintle chain, respectively. Each performs thorough mixing action required.



Water flows from flocculation tanks to two-compartment, 38 x 70 ft. settling tank, containing Straightline Sludge Collectors. Both are operated by the single Link-Belt 1-hp motorized worm ear drive.

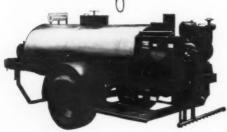
LINK-BELT COMPANY: Plants—Chicago, Indianapolis, Philadelphia, Atlanta, Houston, Minneapolis, San Francisco, Los Angeles, Seattle, Toronto, Springs (South Africa), Sydney (Australia): Sales Offices in Principal Gities.

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101 UTILITY SPRAY TANK

Maintaining our road system is a costly job these days, that is why so many Contractors and Highway Depts. look to the Model 101 to do the work. This 101 is the unit designed to give value received; it's a combination of three units in one.

It has a spray bar for small application jobs, a hand spray for patch work and a pouring pot outlet for crack filling and patch work. Where is there a unit with more utility – more modern efficiency? Not only does this 101 save operating dollars, but its long life saves the maintenance dollar year after year. If you want the best for your money, you'll want the Littleford Model 101 Utility Spray Tank. Write for Bulletin 5.



100% EFFECTIVE

Ace saves you from 60 to 80% on Sewer and Water Main Cleaning Costs!

Ace provides mobilized service anywhere, anytime!

The Ace-system assures you maximum pipe efficiency!

WRITE, WIRE, CALL COLLECT FOR FREE ESTIMATES - NO OBLIGATION

Ace restores water pipe pressure and capacity up to 95% of the original. Foreign material is removed quickly from water mains. Fireflighting operations improve and lower underwriters fire insurance rates are obtained. Yes, the Ace-system has the facts to show you dollar savings, premium efficiency and maximum service—when you need if!

Proper sanitation comes with proper sewer cleaning. Ace-system's modern equipment, coupled with vast experience and technical 'know-how'' makes sewer cleaning effective at an amazingly small cost. Ask to see our 21-minute sound movie of the Kansas City flood. It shows the Ace-system in operation. No cost or obligation.

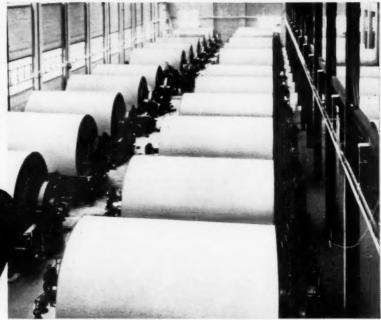
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Designed,
to do
your job
best!

66 Conkey Sludge Filters now installed in one plant of Chicago Sanitary District

The West-Southwest Treatment Works of the Chicago Sanitary District is the largest sewage treatment plant in the world. Here, the huge volume of industrial and residential waste from the heavily populated metropolitan area has presented sewage engineers with an unparalleled challenge. Progressively, the Chicago Sanitary District has met that challenge. Starting twenty years ago within stallations of continuous vacuum filters for activated sludge, Sanitary District engineers have developed the most exacting specifications and rigid requirements for filter designs and performance... culminating in the installation of 66 Conkey Rotary Drum Vacuum Filters for this largest single installation in the sewage field.

These Conkey units incorporate:

Polystyrene plastic cloth backing drainage plates for long cloth life and low maintenance.

Flotating cake discharge scraper.

Protective coatings for filter components.

-and other superior design and construction features.

For equivalent Conkey design and fabrication for your filter installation, write General American. Ask for bulletin No. 100 or for a consultation with one of our engineers.

Other General American Equipment: Turbo-Mixers, Evaporators, Dewaterers, Dryers,

Dewaterers, Dryers, Towers, Tanks, Bins, Pressure Vessels

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Industrial Wastes in the Metropolitan New York Area

UNDER a compact between the states of New York, New Jersey and Connecticut, the Interstate Sanitation Commission was formed in 1936 for the purpose of controlling pollution in the waters of the Metropolitan New York area, which area contains approximately 11,000,-000 inhabitants. The Commission, with the cooperation of the three states, has stimulated the abatement of pollution from domestic sources to the point where 50% of the domestic sewage from the 11,000,000 population is receiving treatment; and by 1953, 75% of the domestic flow will meet the standards of the

This, however, solves only a part of the problem. Distributed along the 1500 miles of coastline of the Interstate Sanitation District are approximately 1500 industrial plants, many of which discharge into the waters industrial wastes containing oils, acids, chemicals, grease, mineral salts, dissolved metals, and animal and vegetable matter. As a first step in the effort to abate pollution caused by industrial wastes. the Commission has made a survev to determine the sources, volumes, characteristics and strengths of these wastes. The results of this survey have been published in detail in "Industrial Waste Inventory, Report No. 1.

Discharge is 515 MGD

This report states that 306 of the 1500 plants discharge their wastes directly into District waters; the remainder either do not generate water-borne wastes or dispose of them through public sewers. Of the 306, the greatest number are chemical and food industries; but the greatest volume is from the petroleum industries. Of a total waste discharge of 515 mgd, petroleum industries, which number but 5% of the total industries, contribute 65.4% of the volume: utilities 14.4%; chemicals 10.1%; foods, 3.0%; and metals, 2.3%.

More important than the volume of wastes is their pollution effects. It is estimated that the maximum potential daily pollution load includes 348,000 lb. of oxygen demand, 358,000 lb. of suspended solids, 95,000 lb. of acids, 66,000 lb. of poisons and 101,000 lb. of grease and oil.

To satisfy this oxygen demand would require all the oxygen from approximately 5 billion gallons of normal unpolluted water, and 14 billion gallons to maintain an adequate oxygen residual necessary to maintain most fish life. On the basis of oxygen demand, these wastes have a population equivalent of 2.100.000.

These figures refer only to the wastes discharged directly into the district waters. Another 436 plants discharge 34 mgd of wastes to public sewerage systems, the effluents from which ultimately reach the district waters. The 306 plants also discharge 1160 mgd of uncontaminated water, emanating from such units as surface condensers and compressors, etc.

Of these 306 plants, 138 provide some degree of treatment before discharge of the 433 mgd of which they are the source. But the "treatment" may consist only of simple screening, grease traps, etc., although a few provide complete chemical treatment.

Says the Commission: "Particularly in reference to poisonous and acid wastes, the impact upon a stream is a function of the concentration of these substances in the stream rather than of the absolute quantities discharged as expressed in pounds per day. . . . A concentration of 1 part per million of cyanide or 2 parts per million of copper in the stream may be toxic to aquatic life. . . . The concentration of these substances in the stream is primary in evaluating potential pollutional effects and makes the determination of dilution and dispersion factors as well as the pollution load an essential part of a stream pollution study."

If it is assumed that metals, acids, cyanides and phenols are uniformly distributed in the total daily discharges of 1675 mgd of combined contaminated and uncontaminated water, then the concentrations of these wastes in the flow would be approximately 1.5 ppm non-ferrous metals, 7 ppm acids, 0.3 ppm cyanides and 0.5 ppm phenols. Wastes bearing 1.5 ppm of non-ferrous metals in solution would require 3 parts of dilution water to 2 parts of waste water to reduce the concentration below the toxic level,

assuming the critical concentration for most non-ferrous metals to be approximately 1 ppm. A threefold dilution would be needed to reduce the concentration of cyanides below the toxic level. For phenols, a dilution of approximately 1,000 to 1 would be required.

The daily flow of new water from the rivers tributary to New York Harbor is roughly 16 billion gallons. Assuming that this flow does not contain any of the pollutants referred to above, a dilution of approximately 9 to 1 is available for the industrial discharges. But the wastes are not uniformly distributed in the industrial discharges, nor the discharges uniformly mixed with diluting water. This serves to emphasize the need for analyzing and interpreting the data on a local basis so as to account for local variations in dilution and disper-

Controlling and Repairing Pavement Cuts

More than 2,300 utility cuts have been made in the pavements of Boulder, Colo., during the past two years, with deteriorating results so far as the condition of the streets is concerned. To remedy this condition in the future, the city manager has recommended: (1) That cuts made in a pavement within five years after placing shall be permitted only in emergencies and that a penalty payment be made; and (2) that future pavement cuts be made only by city forces, with permanent type repaying, and costs included in the permit fee.

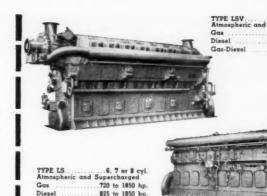
A Temporary Plug for Water Mains

In laying a 36-inch cast-iron water main in Springfield, Ill., the contractor stops the end of the pipe last laid, when work is discontinued at night or for any other considerable length of time, by means of an air-inflated plug consisting of an automobile inner tube with a disc of 1/16-inch gauge metal placed on each side with a rolled edge to fit the bell of the pipe. The diameter is such that when the tube is inflated it makes such contact with the iron pipe that it cannot be withdrawn readily without releasing the air. It weighs about 40 lb. and was inexpensive to build. The complete job is described in another issue of Public Works (May, 1952).

1440 to 3700 hp. 1650 to 3700 hp.

1650 to 3700 hp.

• Identified here are five of the most popular Cooper-Bessemer stationary engine types—in a power range from 290 to 3700 bhp. Not only does each type offer variety in the number of cylinders, but most are available as gas engines, gas-



WHEN IT COMES TO POWER . . .

the better it "fits", the less it costs!

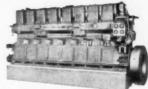
diesels or full diesels. Moreover each type comes either atmospheric or supercharged.

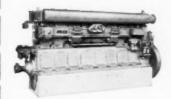
This gives you some idea of how well Cooper-Bessemer 15 prepared to meet your power requirements 1deally — with the engine qualities that mean a whale of a lot in trouble-free service and especially in low over-all operating costs!

If your plans call for defense-supporting power, be sure to check with Cooper-Bessemer. Get all the facts on features that pay off for Cooper-Bessemer users time and time again.



TYPE IS	. 7 or 8 cyl. ercharged
Gas37	5 to 1500 hp.
Diesel	0 to 1500 hp.
Gas-Diesel 43	0 to 1500 hp.

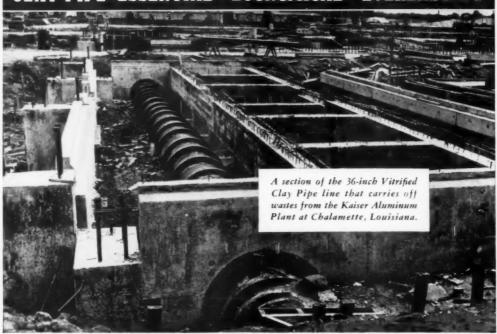




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CLAY PIPE-ESSENTIAL * ECONOMICAL * EVERLASTING



HUGE Vitrified Clay SEWERAGE SYSTEM serves the New Kaiser Aluminum Plant

KAISER Aluminum and Chemical Corporation's new plant has started to add to the nation's critical supply of basic aluminum. By the end of 1953, the multimillion dollar plant will be producing 200,000 tons of the vitally-needed metal annually.

Industrial wastes, high in fluorine and hydrochloric acid content, are reliably handled by an 11,500 ft. system

of Vitrified Clay Pipe.

In every city where industrial wastes flow into municipal sewers, Vitrified Clay Pipe is the one chemically inert material you can count on for unfailing service. Acids and alkalies can't affect it — today or fifty years from now. It never wears out.

NATIONAL CLAY PIPE MANUFACTURERS, INC.

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Wherever Reliable Performance-Proved Pipe Is Needed, Specifications Call for Vitrified Clay

Orlando, Fla. (Air Force Base)						74,000	ft.
Morrisville, Pa. (New Steel Defense P.	lan	(3)				300,000	ft.
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Tucson, Ariz. (Air Force Base)						440,000	ft.
Panama City, Fla. (Municipal Expansion	n)					450,000	ft.
Limestone, Maine (Air Force Base) .						65,000	ft.
Rantoul, Ill. (Chanute Field)						158,000	ft.
Bakersfield, Calif. (Municipal Expansio	n)					313,000	ft.

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GLAY

PIPE

C-852 2

SEPTEMBER 1952 VOLUME 83 • Np. 9









PUBLIC WORKS MAGAZINE

Few Customers, Large Pumpage at

GROTON WATER WORKS

OCATED on the Thames River opposite New London, the Borough of Groton, Conn., covers an area of approximately four square miles and has a population of about 9000 persons. The population served by the water department, however. is 18,500 in summer and 17,000 in winter, including as it does, about 3/5ths of the Town of Groton, covering nearly 20 square miles. However, the actual number of customers of the water department is about 1800. "Uncle Sam's" Submarine Base (3000 personnel) and the U. S. Coast Guard Training Station on Avery Point (1000 officers and men) are but two customers, and 1200 Federal Housing units in the area represent five customers. Three major industries:

L. F. DUTTON.

Superintendent, Department of Utilities, Borough of Groton, Conn.

The Chas. Pfizer Co. (pharmaceuticals), a nylon thread plant, and the Electric Boat Co. (where Pres. Truman recently dedicated the keel laying of the first atomic powered submarine), are all large consumers of water.

Peak consumption occurs in the summer, but water pumpage also goes up in the winter. The winter increase is undoubtedly caused by housing units running water to prevent freezing. Near the submarine base is one section of temporary homes of 1000 units, housing about 3600 persons, with an average consumption of 96 gpcd. Another housing development of 700 persons in 200 units uses 48.5 gpcd, while a third housing unit of 700 persons uses only 40 gpcd.

The average daily pumpage for the water plant is 4.2 mgd, the maximum is 6.2 mgd. The submarine base uses 0.75 mgd and the Chas. Pfizer Co. uses 2.0 mgd of fresh water and 14 mgd of salt water which it pumps.

Fifteen customers (or ¾ths of one percent of the total) account for 80 per cent of the water consumed. These accounts include the Navy, housing units, industrial customers, and wholesale customers. There are 25 large meters in the Borough



● EXTERIOR of the filter plant. Capacity is 4 mgd, with provision for another 2 mgd increase.

system, all of which are read regularly every week.

The Surface Supply

The public water supply is collected from the 14.5 sq. miles of watershed which feed Great Brook. The safe present yield of the supply is 6.0 mgd, with a potential of 10 mgd. The storage system includes the main Groton Reservoir (185 mil. gal.), Smith Lake (150 mil. gal.), Buddington Pond (25 mil. gal.), and Pohequonot Pond (20 mil. gal.); the Poheggnut Reservoir development (completed June 10, 1952) will impound 200 mil. gal. Plans have been made for new reservoirs of 600 mil. gal. capacity to be developed when needed.

An interesting feature of this water supply is found in the record of reservoir elevation over the months. Smith Lake acts as the spill and normally the water spills over the flashboards at Elev. 23.5 from Christmas Eve to July 3, each year. For the next 24 days, the water level drops an inch per day and for the following 16 days, 3/4 inch per day. The total drop in 40 days is 3 ft. Thereafter, the water level drops more slowly until the autumn rains start to fill the lake again. During this period of slow fall, when the lake level is practically constant, the safe yield is 5 to 6 mgd. Practically all of this supply comes from ground water storage in a glacial deposit at the lower end of the basin.

Treatment Plant

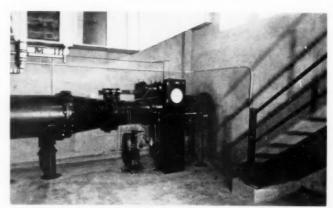
In 1939, the Borough completed a modern filter plant having a design capacity of 2 mgd, with chemical feeders; coagulation; sedimentation; four 0.5-mgd filters; chlorination; and corrosion control with lime. Three high lift pumps of 900, 700, and 500 gpm were installed. The cost of this plant was \$173,000.

Ten years later, the capacity of the plant was doubled to meet the demands of a growing community and industrial development; and structural provision was made for a third 2 mgd increment. The cost of the additions of 1949 was \$638,000, a figure we consider a sad commentary on the effects of inflation.

Both the 1939 and the 1949 halves of the plant were designed by Metcalf & Eddy, Cons. Engrs. of Boston, Mass. Both units are equipped with Allis-Chalmers centrifugal pumps. There are two low lift pumps of 2100 gpm capacity and a third is planned. Present high lift pumps include one each of 1500, 1200, 900.



• FOUR Omega feeders deliver alum, lime and activated carbon.



· WASH water rate controller in the new plant is by Builders.



PORTION of the filters, showing the filter operating tables.

and 500 gpm capacity. One more 1500 gpm pump is planned.

Metering equipment includes Builders-Providence Venturi tubes and meters, recorders, loss of head and rate of flow gauges, and rate controllers. The plant is equipped with Wallace and Tiernan chlorinators. The new half of the plant has a Builders wash water rate controller and four Omega Loss-in-Weight gravimetric chemical feeders: one for alum, two for lime and one for activated carbon. All four chemical feeders are equipped with dust collectors and three have nonflood devices. The present clear well has a capacity of 0.5 mil. gal.; doubling this well capacity is now in progress.

The fact that much of the supply is from a ground water aquifer affects the character of the supply over the year. The color goes up to 125 in the winter and down to 40 or 50 in the summer, as the ground water begins to supply the reservoir. Raw water turbidity is low and is

no problem.

Total hardness averages 16 to 20 ppm in the raw water with a CO₂ content of 3 to 6 ppm, alkalinity of 6 to 9 ppm and a pH of 6.5 to 6.9.

In spite of the high cost of the second half of the plant, we do feel that we obtained some increased value. For example, we find that coagulation is better in the newer half of the plant; partly due, we are convinced, to the operation of the Omega chemical feeders and partly to improved mixing facilities. In the new units, a better floc is produced with only 165 lb. of alum per mg (and 42 lbs. of lime), whereas the older unit requires 183 lb. of alum per mg and 43 lb. of lime, and produces an inferior floc.

Other chemical treatment includes the addition of 82 lb. of lime per mg as a post-lime treatment to correct the pH to about 8.1. Approximately 42 lb. of chlorine are added per mg. Pre-chlorination takes place in the raw water discharge line as it enters the plant and averages 36.5 lb. per mg in the old unit and 34.5 lb. per mg in the newer unit. Post-chlorination takes place in the filter effluent line about 25 ft. after post-lime treatment, with approximately 6.4 lb. of chlorine being added per mg. Post-chlorination contact time is from 2 to 3 hours in the present clear well. Water pumped from the clear well to the distribution system has a free residual chlorine content of 0.1 to 0.25 ppm.

Traces to 0.1 ppm of residual

chlorine are found in the ends of the distribution system 6 miles away. Bacterial tests are now being made in the Groton plant and the State Health Department Laboratory analyzes three to four samples a month. No presumptive coliform bacteria are found in the finished water.

To date, no activated carbon has been used, although a ton of carbon is kept on hand for emergency in case of severe tastes and odors. The odor value of the water is from 1 to 3 "Earthy" by the old method of determining odor values. No odor is detected in the finished water.

Distribution System

Three transmission mains carry the supply from the pumping station to the distribution "grid"; a 16-in. cast iron main to the northerly end, ε 10-in. cast iron main to the middle section and a 20-in. prestressed reinforced concrete main to the southerly section. The distribution grid consists of 40 miles of mains up to 20-in. in size, not including mains owned by the Federal Housing Authority and the United States Navy.

Before chlorination began in the 1920's, an old 10-in. main showed heavy tuberculation. Since chlorination began, tuberculation has cleared up as indicated by test sections from the main.

There are two standpipes on the system (about 1.5 mil. gal. capacity each); one is a pre-stressed reinforced concrete reservoir, the other is of steel.

The plant value based on accumulated cost is \$2,019,871 and the outstanding funded debt was \$667,-

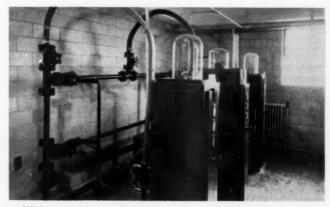
000 on March 31, 1952. Gross revenue in the year ending March 31, 1952 was \$138,480 and gross expenditures for the same period were \$150,290, representing a loss of \$11,810.

There had been no change in water rates since 1920, which accounts for the poor financial showing of the water department in recent years. The Utilities Department and Metcalf and Eddy recently completed a rate study and recommended increased rates for the system. On April 1, 1952, a new rate was adopted.

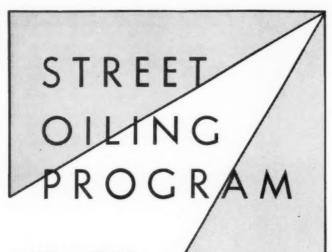
Because of the growth of the community and increased demand for water (maximum demand rates have reached 47 per cent above average capacity), it is planned to increase the capacity of the plant to 6 mgd. Plans to increase the capacity of the clear well and to add both high and low pumps are part of this future project.

Strenuous efforts to enlarge facilities to "keep up" with our load growth have barely met the needs; and the further postponement of the long proposed Ledyard Reservoir will endanger our present ability barely to meet the needs. The Connecticut State Department of Health has recommended the construction of this reservoir in 1952 and the Utilities Department is currently having preliminary surveys and design engineering done to develop cost estimates so that proposals for immediate construction and financing can be made.

Plans are now under way for the construction of a sewage plant, which will also be operated by the Department of Utilities.



• With pre- and post-chlorination, free residual is 0.1 to 0.25 ppm.



CARL C. FAGERLIND,

Street Commissioner, Waterloo, Iowa

N the area of 32 square miles comprising the city of Water-loo, Iowa, there are approximately 290 miles of streets and 45 miles of alleys. About 105 miles of streets are paved with a permanent type paving. The remainder are either oiled, gravel and cinder, rock surfaced, or just plain dirt. This is the story of how we maintain them. But, first:

Waterloo is divided by the Cedar River. The "East" side of the city is located on the flood plain of the river. The soils are "light" soils, silty sand, sandy loam, and sand. The land is flat, with very little chance for drainage. The "West" side of the city is on higher rolling land adjacent to the river. The soils on this side of the river are the heavier type soils, clay, and clayey loam underlain with sand and sandy gravel. The surface drainage is good.

Prior to 1937, the cost of the maintenance on the dirt streets in Waterloo was particularly high after the spring break-up and after each rainstorm. This was due to the nature of the soils on the West side of the river and the lack of drainage on the East side of the river. During dry weather the dirt streets became dusty. People were continually complaining about the "lousy" condition of the dirt streets and demanded that something be done about it.

In 1937 a trip was made to Minneapolis to investigate that city's street oiling program. Minneapolis was combining a special light grade loo's budget for the amount of work to be done.

Upon returning home we came to the following conclusions: (1) Due to the sad state of the budget it was decided to try mixing the road oil with the existing material in the streets without the addition of gravel or rock. It was felt that the mixture of the road oil and the lighter type soils would produce a good base. As most of the really bad spots on the heavier soil streets had been reinforced with gravel, rock or cinders, it seemed likely that the addition of the road oil should produce a fair base. (2) The program was to be set up on a dust-prevention-only basis and assessed to the abutting property. (3) The oiling was to be split into a 3-year program in order to keep

PLEASES PUBLIC

of slow-curing asphalt with a mixture of hauled-in gravel, and earth from the existing streets, with excellent results. The resulting surface was dust-free and the mixture of oil, gravel, and earth produced a base that held up well under all conditions of weather and traffic. However, the cost of the street-mixed oil, gravel, and earth combination was a little too high for the amount of money set up in Water-

each year's assessment low. Splitting the program also enabled the city to do more streets per year with the money available.

The first year, we used 20,000 gallons of oil and completed 28 blocks of streets. Last year we used over 400,000 gallons of oil and completed approximately 500 blocks of streets. The growth of the program has shown the soundness of the decisions reached in 1937.



 MIXING of oil and existing aggregate is done with a Seaman mixer.

With the growth of the program it became necessary to develop a method for selection of the streets that were to be included in each year's oiling program. The selection is done in the following manner: (1) New streets are added to the program by petition from the property owners. (2) Streets, after the first oiling, that is "old" streets, are automatically included in the next year's program until they have received three oilings. (3) After a street has received three oilings, it is dropped from the yearly programs unless it shows a definite need for reworking. The need for reworking an oiled street is determined by a pre-oiling season inspection of all oiled streets by the Street Commissioner and the City Engineer.



• FINISHING with drag. Street is ready for traffic, except gutters.

AND REDUCES MANY COSTS



 ETNYRE distributor, Adams and Caterpillar graders and Seaman mixer are essential parts of the team.

After the program is set up and the necessary legal procedure carried out, construction is started on both new and old streets. The work is done entirely by the Street Department with its own equipment. Two crews, consisting of 17 men (operators, drivers, and helpers) using one tank car heater and booster, two oil distributors, four graders, two trucks, and two Seaman mixers are used throughout the oiling program.

The first step in oiling a new street is the cutting of the gutters, using the existing grade and crown as a guide. The amount of material removed from the gutters should be enough to cover the street, for the width to be oiled, to a loose depth of ¾ to 1 inch. This material is then windrowed in the center of the street and flattened to receive the oil.

Old streets are scarified to the bottom of the existing oil, the gutters are cleaned and the material is pulled into a windrow in the center of the street and flattened to receive the oil.

The road oil used is the same light grade, slow-curing, cut-back asphalt used at Minneapolis. The road oil is applied at 150° F. and at a rate of approximately 34 gallon per square yard for new construction, and approximately 1/2 gallon per square yard for old construction. Experience has shown that there is no set formula for determining the exact amount of oil to use for the proper mixtures. The existing materials in the street may vary greatly in the same block. A little experience will enable the foreman to mix the materials by color. If mixed too rich, or dark, the oiled dirt will bleed and shove. If the mixture is found to be too dry after laying, a light penetration shot can be applied to the top.

Mixing is done with a Seaman mixer and grader combination, the Seaman doing the mixing and the grader rolling the windrow over for another pass with the Seaman mixer. If a Seaman mixer is not available, the entire mixing job can be done with a grader alone.

After the windrow of material is thoroughly mixed, the windrow is split and a penetration shot of about 0.2 gallon per square yard is applied to the undisturbed subgrade. The mixed windrows are then laid,

shaped, and dragged with a king drag. No rolling is done by the Street Department forces. The street is opened to traffic immediately after the dragging operation and the rolling is done by the traffic. Within a day or two, road oil is applied to the gutter at the normal rate of 0.2 gallon per square yard. If the grade of the street is steep, a heavier application is made to prevent washing.

About 15 to 20 blocks of this construction can be accomplished per day with the crews and equipment listed above. About 5 tank cars or 50,000 gallons of road oil are used each week.

Costs of the Work

The cost of this type construction is low. Due to the variation in the amount of oil applied, the program for the year is split into four classifications. These are: First Oiling, Second Oiling, Third Oiling, and Re-Oiling. The Re-Oiling classification includes those streets that need reworking after the third year. The total cost of the oil; freight on oil; three cents per gallon for equipment charge; gasoline; lubricating oil; range oil; diesel fuel; publications; notice cards; post cards, engineering department supplies; and street department, engineering and clerk's office payrolls, are computed for each oiling classification. The total square yards, including intersections, are also figured for each classification, and a unit cost per square yard is calculated. The costs per square yard for our 1951 oiling program were: 13.8 cents for first oiling; 11.8 cents for second oiling; 11.8 cents for third oiling; and around 11 cents for re-oiling.

On the basis of the normal three years of oiling, the cost to the property owner for the completed job is 36.4 cents per square yard. On a frontage basis, for a 24-ft. street, the cost is approximately 18.4 cents per front foot for first oiling and 15.7 cents for second and third oilings. The total cost per front foot for the three-year program runs to 49.8 cents per front foot. The total cost of the three-year oiling program to a property owner with a 50-foot frontage, for a twenty-four foot street, is approximately \$24.90.

When the low cost of this dust free, all-weather street is assessed against the abutting property, on a frontage basis, there are no complaints and, except for those properties not assessable by law, no deficiencies. As has been stated, the oiling program was originally set up on a basis of dust-prevention alone; but dust prevention has been only one of the many benefits that have resulted from the oiling program. Some of these additional benefits are:

(1) The oiling program saves the city on maintenance: The oiled streets do not require blading after each rainstorm; freezing and thawing during the spring break-up does not seem to affect the oiled streets; the cost of street cleaning on the paved streets is lowered because there is no mud from the oiled streets to be carried onto the paved streets; dirt and mud are kept out of the sewers; the oiled surface absorbs heat and melts the snow sooner; and the smoother surface on the oiled streets makes snow removal easier.

(2) The benefits derived from the oiling being done by the Street Department are many: The cost of the oiling is lower to the taxpayer when done by the Street Depart-



ment, for the oiling program fills out the year-around program for the Street Department's heavy machinery and men. In the spring the Street Department is engaged in the maintenance of the outlying dirt streets. In the summer and fall the Street Department is engaged in oiling and seal-coating operations. In the winter the Street Department takes care of the snow removal.

Lower cost in all Street Department operations is obtained by having the heavy equipment, used in the oiling program, available for all types of duty throughout the year. Waterloo has the lowest cost for snow removal of any city in the state. The snow removal budget has been cut from \$35,000 per year to \$7,000 per year since the purchase of the heavy equipment for the oiling program. Seal-coating on State Highways through the City is done by the Street Department at a lower cost than can be done by a contractor. Thus more blocks of sealcoating are done each year with State money. The Sewer Department and Street Department utilize the tank car heating equipment to thaw out sewers, catch basins, and culverts during the winter and spring.

The oiling program builds toward a permanent base. Within a year or two after the completion of the program, a seal-coat can be placed on the oiled streets that were curbed and guttered prior to the first oiling, and the oil-bound base and seal coat can be used as flexible pavement.

Practically all of complaints from the people on the outlying streets are eliminated. Many of the lower income bracket people, buying their own homes, are benefited by being taken out of the mud with an allweather type street. There is no undue financial hardship on them during the period in which they are paying for their homes. Oiling provides a low-cost all-weather street in areas where the property values will not stand the cost of a higher type surfacing, and these oiled streets are acceptable for F.H.A. loans.

Streets can be oiled even though all the utilities are not in place. All the advantages of the oiled street can be had by the property owners until the utilities are in place. The cost of reworking an oiled street, after a utility is in place, is very low.

As can readily be seen, the benefits derived from the oiling program are distributed not only to the property owners involved, but are distributed to all the taxpayers in the City through the increased efficiency in the Street Department's year-around output.

The year of 1950 was the peak year for street oiling in Waterloo. The oiling program has now begun to taper off, but many of our older concrete and asphalt streets are in need of seal-coating. The equipment for doing this work is available and paid for.

The City is now in the process of building a number of parking lots. The surfacing on these lots is a water-bound rock base and sealcoat. The equipment for doing this work is available and paid for.

The City of Waterloo is well satisfied with the results obtained from the low-cost street oiling. It feels that the success of the program has been definitely proven by the small number of objectors from the thousands of people benefited.

The data in this article are based on a paper presented at the Third City Engineers' Conference, held at Iowa State College.



A Small City can afford

C. N. HARRUB,

Consulting Engineer, Nashville, Tenn.

SOME ten miles of vitrified clay sewer lines and a complete sewage treatment plant have been installed in Mt. Pleasant, Tenn. This small city of about 3,000 population is located in a rich agricultural section and its largest single industry is the mining of phosphate rock and its conversion into fertilizer. The total cost of the sewerage system and the treatment plant was \$244,340.58. Provision was made for approximately 1,000 house connections.

The plant was designed for a population of 3,500, with a daily per capita flow of 100 gals. Based on population growth and water consumption, design flow is not expected for a number of years.

The sewerage system, which is entirely of vitrified clay pipe, includes 43,684 ft. of 8-inch, 5,542 ft. of 10-inch, 1,744 ft. of 12-inch, and 1,768 ft. of 15-inch, with 203 manholes. The original contract price on the work amounted to \$135,-297.50, but the addition of sewers in several streets not previously included in the program increased

MODERN SEWAGE TREATMENT

the cost to \$145,136.95. The contractor on the sewerage system was the G. E. Moore Co., Greenwood, S. C.

The 8-inch sewers ranged in depth from 4 ft. to 12 ft., and bid prices were from \$1.45 to \$5.00 per foot. The 10-inch sewers were laid 4 ft. to 8 ft. in depth, and bid prices were \$1.65 to \$2.57 per ft. On the 12-inch lines, which ranged from 4 ft. to 10 ft. deep, bid prices varied from \$1.95 to \$4.00 per ft. Prices on the 15-inch lines, which were also at depths of 4 ft. to 10 ft., were \$2.68 to \$5.00 per ft."

For the disposal plant, which was awarded to the Stein Construction Co. of Chattanooga, Tenn., the contract price was \$99.203.63. The plant

consists of the following units: An Infilco griductor, with a by-pass in which is installed a screen with bars spaced at 1-1/16 ins. apart. A receiving well from which the raw sewage is pumped to the primary clarifier. A dosing tank and a low rate trickling filter designed for a loading of 400 lbs. of BOD per acre-foot. A secondary clarifier and a digester. The clarifier mechanisms and the distributor are Infilco.

The raw sewage receiving well is located under the control house in which are housed the raw sewage pumps and the sludge pumps. The sludge from the two clarifiers and the scum from the primary clarifier are discharged to the digester which is of the fixed roof type. The sludge pumps are so arranged that they can be used to recirculate the sludge if desired. Open sludge drying beds are provided for sludge disposal.

In the design of the filter, provision was made for recirculation, if it is desired, to maintain the volume of flow or for other purposes.

The sludge pump was furnished by Domestic Engine and Pump Co., and the filter recirculation pump was Fairbanks, Morse.

The project was financed by a revenue bond issue, with a pledge of other funds if there should be any deficiency in revenues in any year. Dr. G. C. English is the Mayor of Mt. Pleasant and William Ralston is Superintendent of Sewers. Design and construction of the project was by the C. N. Harrub Engineering Co., consulting engineers of Nashville. Tenn.



 TREATMENT plant, designed for 3,500 people, uses low rate filter with loading of 400 lbs. BOD per acre-foot.

Get better Operation Designed into

YOUR NEXT PLANT



BERNARD WESTKAMPER,

City Engineer, Tulare, Calif.

THERE are items in designing a sewerage system and a sewage treatment plant which, when overlooked, result in operating difficulties or in more costly maintenance after construction.

In the past, sewers were often laid on inadequate grades. With present-day sewage pumps, this is neither necessary nor desirable. Inadequate grades result in the deposition of solids in the sewer lines, requiring more frequent cleaning and often emergency operations. Sewers should be designed to keep infiltration to a minimum, prevent entrance of tree roots and also to facilitate cleaning and to encourage doing this on a regular schedule. Cleaning sewers only when they are stopped up and neglecting them the rest of the time is poor practice. Deposits in sewers and stoppage by roots lengthen the detention period in the sewers, permit decomposition of the sewage and may cause highly objectionable odors at the treatment plant. Also, the hydrogen sulphide produced may affect concrete structures at the plant. It is good practice to provide for annual cleaning of all sewers, with more frequent attention to trouble spots. If a record of stoppages is maintained, the sections chronically causing trouble can be identified and either corrected or given preventive cleaning as is indicated to be necessary

At the plant, sewage should drop clear of the outfall line in order to prevent backing up of sewage and deposition of solids at low flows. A suitable ordinance is necessary to reduce the amount of oil and grease reaching the plant. Grease traps should be required at garages and

service stations and their proper use enforced by frequent inspections.

Pretreatment and Pumping

Pretreatment is omitted on too many plants in order to keep the total cost down. This is a design mistake, which may adversely affect plant operation for the life of the plant. Sand enters into and is discharged from most sewer systems. In some types of clarifiers, it can be removed only by dewatering. It may collect in digestion tanks-and no sludge pump that is made will satisfactorily handle packed sand from the bottom of a digester. A grit chamber or similar device will do material good and should always be installed

Rags, sticks and rubber goods can clog sewage and sludge pumps and interfere with digestion. Piston-type sludge pumps have valves which can be easily cleaned—but who wants to clean a sludge pump valve? A comminutor or its equivalent will reduce these materials to an easily handled size. A hand-cleaned bar screen is no substitute for a comminutor.

The worst mistake made in designing sewage pumping plants is to choose a wet well construction. Even though a dry well installation costs more, it should always be used. Most sewage pumps are subject to clogging. Stoppages in pumps in dry wells can usually be cleared without removing the pump, but pumps in wet wells generally have to be removed when needing attention. It is most aggravating to have to raise the pump out of the sewage whenever stoppage occurs—and it costs money.

Primary and Secondary Treatment

Clarifiers are generally adequately designed though provision for removal of skimmings and oil scum is not always made, resulting too often in the adoption of methods that are costly because of the hand labor involved and are also unsanitary. The best way to clean the various components of a plant is by a hose stream using water under a pressure of at least 60 pounds. Hose bibbs should be located so that no more than 50 ft. of hose is needed at any one location. This saves operator time and helps him to maintain the plant in good shape.

In trickling filters, the principal source of trouble lies in inadequate underdrains. There should be ample openings for ventilation, larger than necessary flow channels, and good grades; and the underdrains should be amply strong to sustain the weight of the filter media (plus the equipment permitted by the engineer for placing the media) without crushing or other damage. It is better to have the underdrains too big and too steep than too small and too flat.

Conveying treated sewage through an unlined ditch may create a maintenance problem through excessive growths of weeds and brush. The frequent cutting or spraying required for control may add materially to operating costs. A pipe line may be cheaper in the long run.

Sludge Digestion

Probably the best way to heat sludge is by means of a heat exchanger. Hot water pipes inside a digester may corrode, or deposits on them may reduce heat transfer. In very small plants, gas utilization may cause trouble. In warm climates, in such cases, it may be better to burn the digester gas. An analysis should be made to compare the cost benefits from utilizing the digester gas in an engine with the cost of electric power.

(Continued on page 114)



ABOUT PAVEMENTS AT BUS STOPS

LEFT, what the finished strip looks like:

FRANK P. HORAN,
Department of Engineering,
Hartford, Conn.

NSTALLATION of reinforced concrete pavement slabs at eight major intersections where heavy buses stop has recently been completed by Hartford, Conn. These are on the city's Main St. Their construction was prompted by the rapid deterioration of the pavement adjacent to the curbs at major bus stops. Design of these slabs is such that they will fit into projected future improvements of Main St.

For many years, street officials and engineers have had major maintenance problems caused by pavement breakdowns at principal bus stops. The old trolley lines were finally abolished in the early 1940's. being replaced by buses. Since that time pavement maintenance costs at areas adjacent to the bus stops have mounted. Brake action (and also starting action) of the buses created a sloughing and waving of the old asphalt, while the base broke down under the heavy buses, some of which weighed as much as 27,500 pounds. In other words, the pavements were being forced to carry loads almost ten times as great as they were designed for.

Main Street was one of the first of the city's streets to be paved. The original construction consisted of a 6-inch hand-mixed concrete slab with no reinforcing and with no special preparation of the base. The concrete was covered with a binder course and a surface of sheet asphalt was then placed. As might be imagined, the pavement, after these many years, was pock-marked by periodic utility cuts, sewer



• SECTION of the strip under construction, showing reinforcing.

trenches and underground utility conversion work. More recently, during the war years, the old steel trolley rails were removed for salvage, creating further havoc and damage to base and surface. The original base, laid in the late 1890's, was resurfaced the first time in 1915, and again about 1942.

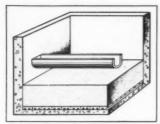
It is appreciated that at some not too far distant date, this main artery through the city will have to be reconstructed and completely repaved, for it is carrying traffic loads for which it was, naturally, never designed. The new slabs are so designed that they will become an integral and matching part of the new pavement when constructed.

The new slabs, all of which are on the busy main section of the street, vary in length from 68 ft. to 155 ft. The latter slab is at Old State House Square, a major stop, and it occupies the entire block. A standard width of 12 ft. was adopted for the new slabs, and the old paving

was cut back plus or minus 2 ft. additional to permit matching the grades with a bituminous concrete connecting collar.

The new pavement is of 10-inch reinforced concrete on a prepared base of 10 inches of processed gravel. Underdrains of 6-inch perforated metal were placed longitudinally under the slab and connected to the sewer system. Concrete was specified to have a 28-day strength of 5,000 lbs. Reinforcing consists of 3/8-inch deformed bars, spaced 24 ins. longitudinally and 5 ft. transversely. Central mix concrete was supplied by Edward Balf Co. The work was done by contract by the Charter Oak Construction Co. Traffic was kept off the slabs for a 10-day curing period.

The 12-ft. wide slab sections, which were screeded and broom finished, were, of necessity, placed with a straight grade, eliminating the old parabolic section at the bus stop sector.



 FIRST design used plates channeled on the under sides.



♠ THREE-point support design was developed by T. R. Camp.



 CONCRETE pier support design is shown in view above.

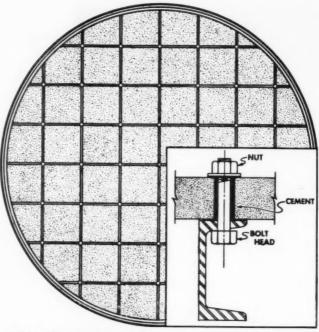
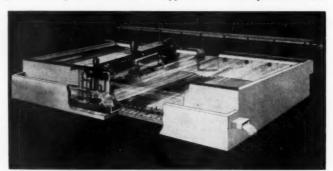
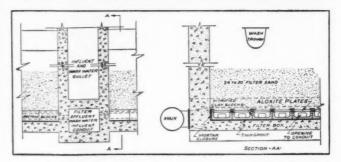


PLATE layout and detail of support for vertical pressure filter.



• HARDINGE rapid sand filter with Aloxite underdrain plates.



DETAILS of Barstow's Clalox porous plate filter bottoms.

HOW TO USE POROUS PLATES FOR THE MODERN WATER FILTER

POROUS filter bottom plates, in a relatively coarse composition, were developed by The Carborundum Company in 1933. The bonded granules in these plates are comparable in size to the smallest torpedo sand or fine gravel generally used in water filter underdrain systems to support the filter media composing the filter. A basic factor is that insoluble aluminum oxide granules are permanently bonded with vitrified ceramic clavs to compose the structure. The resulting material is completely resistant to corrosion and disintegration as a result of continuous contact with any water supply; and it will resist acids and/or other chemicals that may be used for the periodic treatment of filter media.

It was appreciated that these plates could provide an ideal support for water filter media, and the first installation by Harry N. Jenks followed quickly, in 1934. In this design, channels corresponding to conventional laterals were formed directly in the undersides of the porous plates. Thus, the plates had to be bolted to the filter floor or otherwise held down mechanically The design was functionally good and several filters of this design are still in operation. Initial cost of this type of construction, however, was relatively high.

Designs employing plain plates bolted to piers, columns or beams, or even supported and held down by long bolts to form an essentially false bottom, were also proposed. In principle, these followed an idea developed in graduate research. work at the University of Texas in 1927. The method was tried experimentally by Thomas R. Camp at the Providence, R. I., filtration plant. These experimental studies, however, did not utilize the coarse grades of underdrain plates which

FRANK C. ROE

The Carborundum Co.

are essential in order to avoid clogging by solids that will pass the filter media proper.

The first full-scale installations of plain plates, in 1936, employed concrete pier construction. Generally, this method has proved successful, although many improvements have been developed in the techniques of bolting down and of sealing joints. The use of timber piers or beams with plates held by lag screws was tried in Sweden in 1937, and this method has been generally satisfactory. Structural steel supports also have been used, particularly in pressure filters of the vertical type.

Special Designs

Generally successful results with porous plate underdrains and their increased use has prompted the development of at least four patented or proprietary designs. The first of these was the three-point bolt support idea conceived by Thomas R. Camp and now offered by Walker Process Equipment, Inc.

Next, Hardinge Company designed the automatically back-washed filter. In this, a device moves through the length of the filter, washing one narrow section, while the remainder of the unit continues to function as a filter. The advantages of this idea are obvious, as it eliminates the need for special backwash facilities and avoids the necessity for an extra filter to function during backwash.

In 1949, Chief Engineer E. H. Aldrich of American Water Works Company conceived the idea of a complete circular treatment unit in which mixing is accomplished in the center compartment, coagulation and sedimentation in the next large annular compartment, and filtration in a relatively narrow annular section around the perimeter. The filter media is supported by special trapezoidal-shaped porous plates, designed to fit the bottom of the annular filter. The first installation of this design at Alexandria, Va., was described by Mr. Aldrich in the May, 1951, issue of the Journal of the AWWA. Further installations have been made at Greensburg, Pa., and Chattanooga, Tenn.

The most recent innovation is that proposed by E. D. Barstow of Akron, Ohio. This is a block of vitrified clay tile or reinforced precast concrete into which the porous underdrain plates can be inserted and sealed in place with cement. It is best adapted to a filter design of the double box type, with concrete wash distribution manifold extending across the center and with main wash gullet above. Openings through the concrete manifold should be on 12-inch centers corresponding with the block channels below plates.

The advantages of the Barstow design are quickly apparent. Hold-down bolts are eliminated and the supporting blocks are simply grouted to the filter floor. The block sidewall is designed to carry differential pressure through plates with ample factor of safety. Initial estimates indicate that the cost is lower than other designs on an area basis.

It should be stated here that all designs utilizing porous plates have functioned completely satisfactorily without any layer of fine gravel between plates and filter media. In several plants a single layer of such gravel has been used, and a few

engineers favor that addition. While it can do no harm, there is no established benefit and the total filter cost is increased slightly. For these reasons, the use of a fine gravel layer is not recommended.

The Carborundum Company has continued to improve the material, and now supplies three grades for supporting basically different sized media. The Company's position, however, will remain solely that of a material producer serving engineers, filter operators, contractors, and equipment manufacturers.

While the designs discussed thus far assume new filter construction, it is apparent that most of them are equally well adapted to the rehabilitation of old filters. Actually, a substantial number of the installations made to date have involved the improvement of old filters, permitting them to operate according to the best modern practice.

If, for example, existing filters with graded gravel filter media support are shallow, porous plates can be installed without increasing filter box height. Eliminating the gravel will lower the filter media and/or increase its depth, either of which may be desirable. The tremendous saving in reconstruction cost through the use of porous plates is quite apparent.

tion requirements previously outlined and has also established certain limitations as to application. The chief and somewhat obvious limitation is that no filters should be equipped with porous plate underdrains where after-precipitation occurs in the water to be handled. That condition will result in serious trouble with any filter bottom, but is likely to cause unusually early difficulty with porous plates. This may occur in lime softening plants and possibly in iron removal plants.

Several iron removal and lime softening plants now use porous underdrains successfully. There have been four softening plant installations, however, where stabilization was quite incomplete when the water reached the filters. Carbonate incrustation occurred throughout the filters, underdrain plates and beyond. Such incrustation (coating) and possible ultimate closing of pores responds to acid treatment without harm to plates. However, in each of the four plants in question the required treatment cycle and/or necessary facilities made it impractical and the plates were removed.

In the case of one iron removal plant, the retention period between aeration and filtration was practically non-existent, so that iron hydroxide formed through and beyond filters, including the porous plate underdrains. Regular porous plate cleaning with acid in this particular plant has been practical, so that the filters have given good service for many years.

These contrasting experiences indicate that porous plate underdrains for lime softening, and possibly for some other types of treatment plants, should be utilized only where the reaction is quite complete, at least by the time the water reaches the filter bottom. That is the normal planned condition, but there are some planned or unavoidable exceptions. The limitations as stated should be recognized for such exceptions.

Construction and Installation Essentials

As in the case of any really new development, there were unfore-seen "bugs" surrounding the installation of porous plate underdrains. Some of the following requirements now seem to be quite elementary but, without prior practice to draw upon, they were not immediately apparent.

(a) All plates should be carefully inspected and "rung" for soundness before installing as a check against handling and transportation damage. They must be handled with reasonable care thereafter, and not dropped or struck with a heavy object.

(b) Hold-down bolts must be thoroughly anchored in addition to the obvious necessity of their being of a material that will not deteriorate in the particular water to be filtered. Hook or ell anchorage is preferred to a plain bolt head, which might turn.

c) At least some, and preferably all, of the plate bedding and joint sealing material should be of a resilient type. This is to compensate for possible slight movement of units (especially in pressure filters) and for temperature variations.

(d) Plates must have complete bearing at all support surfaces and all joints must be thoroughly sealed.

(e) Reasonable care should be taken to prevent spillage of joint sealing cement or other foreign material on plate surfaces. Protective covers can be used, if desired for this purpose.

(f) Washers should be at least 2-inch diameter or square and have complete area contact with plates through sealing cement on which they bear.

(g) Nuts should be tightened to approximately five pounds pressure.

(h) Construction debris, excess joint sealing cement, and all other foreign material must be removed from below and above plates during installation to prevent subsequent clogging thereby.

 (i) Each filter should be backwashed before filter media is applied as a check on perfection of installation.

(j) Filtered water supply only should be used for backwashing.

Operators Report

Since the original full-size installation of ceramically bonded porous underdrain plates in 1936, there have been a total of approximately 300 installations in plants ranging from perhaps 0.25 mgd up to 40 mgd capacity. These include filters (and some softeners) handling almost every conceivable type of water and operating under almost as many different conditions as there are installations.

By and large, the overall results in this widespread experience have been highly satisfactory. Some operators have learned better methods of installation and operation "the hard way", but the general opinion of porous plate filter bottoms, especially on the part of technicians who have operated filters with other types of underdrains, is exceedingly favorable.

The experience gained has established the construction or installa-

Operation Practice

The operation of filters and softeners equipped with porous plate filter bottoms generally has followed the basic rates and rules that have proved sound for any workable underdrain system supporting similar media. In other words, the filtering (or softening) media, and the degree of filtration or treatment expected, control operating practice

(Continued on page 115)

TRENCH DRILL Speeds laying of

IPE LINES UNDER ROADS

N two Ohio counties, Trumbull and Mahoning, trenching through roadways is restricted, yet the necessity frequently arises for laying new pipe lines to provide increased customer service. In many sections of Warren, the center of Trumbull Co., the streets are bordered with stately trees and the streets which the new lines have to cross are paved with brick, adding more handicaps to construction.

The reasons for the restriction on cutting through streets is obvious. Not only does traffic get tied up in bottlenecks, slowing the pace of business and transportation, but the cut areas of the streets are never the same again. The most efficiently patched sections are apt to sag in the center and to crack at the edges. requiring every year new and costly maintenance measures.

The Fithian Construction Co. of Youngstown, avoids the necessity of cutting street surfaces by using the McCarthy utility type trench drill which is manufactured by the Salem Tool Co. This type of operation is speedy, and permits easy passage under pavements, driveways, railroad tracks and similar obstacles. When trees are encountered they can be bored through or passed under. Time saved by such drilling equipment, according to Phil Markovitz, construction foreman for Fithian, is surprisingly great. The drilling machine may complete in one day a job that would require many times as long by routine handwork methods. For

instance, to cut down a large tree and dynamite out the roots may take two days for several men. Using the trench drill, the tree is either bored through or passed under, almost without delay.

The McCarthy machine drills sections up to 250 ft. long; and when the drill head emerges at the end of the run, alinement is sufficiently close to permit easy tie-in with other pipe lines. To insure accurate alinement the first time, observation holes are spotted at intervals of about 15 ft. along the line that it is desired to follow. As the head of the drill enters these holes, it is adjusted as to direction, if necessary, by using boards or bars.

Trees are not a serious obstacle. In one instance during the Warren



HOME-owners are happy to find that it isn't necessary to tear up or block their driveways.

• DRILLING machine augers a pipe line hole under wide pavements and street intersections.



pipe-laying project, a tree with a trunk about 3 ft. in diameter stood directly in the path of the pipe line. As the line could not be laid under the tree nor led around it, a special wood auger head was used and the drilling machine cut a 4-inch hole directly through the base of the trunk. The City of Warren had a Davy tree expert evaluate this practice and he reported that drilling a small sized hole through the trunk underground was not injurious to the tree.

The procedure used by the Fithian Co. is time-saving and sufficiently accurate. Starting at one end of a block, a trenching machine first digs a double-width trench long enough to allow placement of the drilling machine. The depth may be whatever is needed for the particular job. Using a truck or tractor equipped with a boom, the drilling machine is placed in the trench. It is then lined up longitudinally and vertically. A level is used for the latter phase, since vertical alinement must be exact. If desired, instrument grades may be taken on the core of the auger.

Augers are 6 ft. in length and are available in diameters from 6 ins. to 36 ins. For the Warren pipe line projects, which were for gas pipe, 4-inch and 6-inch augers were used—the 6-inch under railroad tracks where a protective casing was placed through which the 4-inch line was threaded. After driving each auger forward, the machine reverses itself, withdrawing enough of the auger from the hole to permit attachment of another section.

When about half of the run—usually half of a block length—has been drilled, the auger is withdrawn, the machine is hoisted out of the hole by the boom equipment and the work is started at the other end of the block. The machine may work backward to drill the remaining length or it may be turned around.

When the auger is withdrawn, a line is threaded through the hole and this is used to pull the pipe through. A wooden plug in the lead pipe acts a guide. Each pipe length is welded or coupled as the pipe sections are drawn into the barhole.

In crossing streets, spotting or alinement holes have not been necessary. Unless the drill runs into large, hard rocks, the drilling is straight and true. When sandstone is struck, a special cutting head is used. If granite is encountered, then an access hole must be made through the payement and the rock removed.

 DRILL head "holes through." Good accuracy is obtained, with reasonable care, even on sections up to 250 ft. long.

Studies in Composting Organic Refuse

SCIENTIFIC principles and prac-tical considerations involved in composting of garbage are being studied at the Sanitary Engineering Research Laboratory of the University of California. In cooperation with the Vector Control Division of the California State Health Department, special studies were made of the relationship of the house fly to composts. In the study, independent composts of cow manure and municipal refuse were used. While the work was not exhaustive, it demonstrated the unsuitability of the compost pile as an environment for flies, and the lack of interest that flies had in the compost material. In addition, the study supported the general conclusion that fly nuisance around a compost operation would be related to "housekeeping" rather than to the compost itself. Further study of flies in manure composts is being conducted by the State Health Department at Fresno, where the temperatures are more favorable to flies than at Berkeley.

Previous pilot studies established the optimum conditions for composting organic refuse with straw added for moisture control and as a source of carbon. To approximate more closely the conditions found in city garbage, a series of experiments were begun, using paper instead of straw. This substitution at once presented new problems, such as the need for establishing a new optimum moisture content, determining the minimum amount of turning, and learning the environmental conditions which inhibited the development of the actinomycetes usually responsible for much of the carbon utilization

Pilot Studies

Two bins, each 3 feet square and 4½ feet deep were filled with chopped garbage and paper. Suspecting that excessive moisture resulted in anaerobic conditions with a consequent inhibition of the development of actinomycetes, and desiring to learn the maximum carbonitrogen ratio permissible for rapid and successful composting, the percentage of paper was made quite high—20 percent of the total weight of the material to be composted. This resulted in a carbon-nitrogen

(Continued on page 91)

DUAL FUEL ENGINE SAVES \$25,000 IN A YEAR

ONVERSION in August, 1950, of a 1600-hp Fairbanks-Morse diesel at Crete, Nebraska, to dual fuel operation has resulted in a fuel savings of over \$25,000 during its first year of operation. Use of cheaper natural gas rather than all diesel fuel has resulted in such marked savings that an additional F-M 1200-hp. dual engine has been purchased and installed. This new unit was started for the first time in December, 1951, and shortly began delivering additional power.

Crete's municipal power plant, built in 1928, now has four units—all Fairbanks-Morse. The two older, smaller diesels, now used for emergency service only, are 360-hp., 6-cylinder, and 600-hp., 4-cylinder. These two engines are still in good condition and were used regularly for peak loads in the past year. The converted unit is a 1600-hp., 8 cylinder engine of 16-in. bore and 20-in. stroke operating at 300-rpm. It drives an 1125-kw, 2400-volt F-M alternator with a 20-kw. direct-connected DC field exciter. This unit was installed in April, 1947, and converted to

dual fuel operation in August 1950. Newest unit is a 1200-hp., 7-cylin-inder, 16-in. bore and 20-in. stroke, 257-rpm., F-M dual fuel engine driving a previously acquired 725-kw., 2400-volt, F-M alternator with a 15-kw. direct-connected DC field exciter. Both dual fuel engines are similar in construction and in auxiliaries. Of the total installed capacity of 3760 hp., 2,800 hp. are dual fuel and 960 hp. are diesel. The

dual fuel engines will carry all of the present load.

The dual fuel engines are capable of straight diesel fuel operation and in event of gas failure will immediately and automatically switch to oil without loss of load. The natural gas does not ignite after compression so a small quantity of fuel oil is injected to cause combustion.

Natural gas with a heating value of slightly over 1000 Btu per cu. ft. is supplied to the plant at 32 psi. The flow to each engine is measured by a displacement-type gas meter. Gas pressure is reduced to 22 psi. before reaching the intake valves on the engine. Current gas rates are about 28 cents per 1000 cu. ft., on a high priority interruptible contract.

Fuel cost on the converted dual fuel unit amounts to 4.62 mills per kw. hr. compared to 8.8 mills per kw.hr. on the diesel engines. Both figures are based on present fuel prices. The saving of 4.18 mills per kw.hr. represents a 47.5 percent reduction in expenditures for fuel. With this one engine alone generations.



MUNICIPAL power plant, built in 1928, is fully modernized.



• DUAL-fuel engine has been a big money-maker for Crete.

ating 6,135,900 kw.hr. in a year, the fuel savings exceeded \$25,000.

Electric generation and distribution is at 2400 volts with plant auxiliaries handled through transformers at 110-220 volts. The plant supplies power and lights to the city of Crete (population 3700) and part of the load for the REA lines in the county. The plant is not interconnected with an electric transmission grid and has maintained a very good service record. Present peak load is about 1800 kilowatts. The electric demand has been increasing at a very high rate-124 percent increase in the past five years. C. R. Weaver is Commission-er, and Leonard Stewart is Plant Engineer.

64



 SHADED areas on map show parishes cooperating in statewide drainage. Left to right, Byron Lyons, chief engineer, Col. J. L. White, director, and the author of this article.

The KEY to BETTER

W. D. BECK,

E. I. du Pont de Nemours & Co., Inc., New Orleans, Louisiana

E NOUGH earth has been moved in 30 parishes of Louisiana during the past decade to have built a canal 18 feet wide and 10 feet deep from Miami, Florida, to Seattle, Washington, assuming of course that a level right-of-way that distance could be secured. This earth moving has been a part of one of the most ambitious public works projects a state has ever tackled—a statewide drainage program!

Many another coastal area of the country finds itself in need of adequate drainage, and the Louisiana project has been a show window for an effective cooperative program, headed by the Department of Public Works and involving assistance by the U. S. Army Corps of Engineers, the U. S. Geological Survey, and approval and financing from residents of the parishes (counties) through which the canals are dredged.

This has not been a cheap undertaking. As Col. J. Lester White, director of the State Department of Public Works reports: "When work under contract as of April 1, 1952, is completed, a total of 111,630,660 cubic yards of earth will have been moved, providing for the improvement of existing channels and creation of new canals totalling 5,261 miles, at a cost of \$15,166,299, exclusive of engineering and cost of bridges and culverts."

Yet the people in the parishes involved, who have voted to finance 60 per cent of this expense in their



• WILLOWS and brush have clogged this Pointe Coupee canal.

areas, are enthusiastic backers of the program. Their enthusiasm is understandable when we look at the rural wealth (an estimated 5,000,000 acres throughout the state) these drainage canals are unlocking.

"Thousands upon thousands of acres have been and are being reclaimed in 30 parishes," Col. White says. "As a result, fertile lands are being cleared and readied for planting, while other acreages have been made available for pasturage to meet Louisiana's rapidly expanding cattle industry."

Why Drainage is Needed

Anyone studying a detailed map of Louisiana's rural areas in the early '40's might have wondered why additional drainage facilities were necessary. The country seemed literally laced with small stream beds which would carry off surface water. Yet the immense area of the state which was either swamp or with a water table only a few inches below the surface showed this water problem was a serious road-block in the path of both agricultural and industrial development.

The statewide survey of drainage facilities in 1941 pointed to the necessity for the dredging and canal building program now in progress. And one of its principal findings pointed to another requirementcontrol of brush and tree growthif these canals are to continue functioning properly. For many of the streams which formed major outlets for drainage were blocked with debris and trees to the point where water overflowed the channels and inundated surrounding land which should have been producing food crops for the people.

The battle to control growth which constantly threatens to clog these

waterways has been fascinating and spectacular. We have been privileged to work with Police Jurymen (the Louisiana counterpart of County Commissioners) in a number of parishes in attempts to solve this problem. Manual, mechanical, and chemical methods have been tried to protect the parish investment in drainage facilities and thwart Mother Nature's attempts to cover the channel beds with a mat of willows, cottonwoods, sycamores and various small brush.

parish are not over a 12-foot elevation. There is some rolling country, but much of the parish is quite level.

This is delta country. It owes its existence to the flooding and earth moving activities of the rivers that border it, in those thousands of centuries before man built levees to keep them in place. Near the bayous, the rivers deposited sand. The finer particles of silt and clay were dropped in sections which are now low woodlands. With abundant subsurface moisture almost anywhere

struction period. Canal beds were dredged, or bulldozed if the bed was fairly dry during summer months, and all growth in that area was presumed to have been removed. But within a year, many types of brush were growing thick on the banks, crowding down into the channel and threatening to clog these new canals.

Here was the same sort of problem that maintenance men face in many sections with roadside brush, but complicated by the nature of

BRUSH CONTROL





 SPRAYING brush: An orchard sprayer is towed along canal bank by a bulldozer which cuts a road through the brush.

♠ AFTER: Sup't. Frank Evans and the author inspect canal bank that has been sprayed with weed killer for brush control.

Rather than attempting to "cover the waterfront," let's look at this situation in one specific parish historic Pointe Coupee Parish, settled by d'Iberville in 1717.

Pointe Coupee Parish lies between the Mississippi and Achafalaya rivers. The surface water problem is not complicated by streams flowing into the parish—it is serious enough as a result of about 60 inches of rainfall per year. The bench mark in front of the courthouse at New Roads shows an elevation of 27 feet above sea level. Some places in the

and a warm, humid climate much of the year, seeds from woody plants have an excellent chance for survival, germination, and growth almost anywhere they fall.

Here is the Problem

It was in such a situation that Frank C. Evans, Police Juryman and superintendent of construction for the parish, found himself facing a tremendous brush problem in the early years of this drainage program. All brush and trees along the canals were cut during the conthe public utility it was necessary to keep free of growth. Brush will not grow in a concrete roadway, but by the second year after canal construction it was doing quite well in the very bed down which the water was supposed to flow. About three-quarters of the canals in Pointe Coupee parish are dry in summer. Here was a fertile field for willows and accompanying brush, and they formed a high barricade completely across some channels.

Mowing or scything the small stems and cutting the larger ones was tried. For every severed stem, root systems sent up a dozen new sprouts. The ground was soft in most sections and it was thought the growths could be "pulled" out, root

(Continued on page 111)



• MODERN highways, like this section of the New Jersey Turnpike, require the best concrete.

CONCRETE

THE original concept of concrete that it is a mechanical mixture of coarse aggregate, fine aggregate, Portland Cement and water is still good with the understanding that the coarse and fine aggregates are inert materials and that some of the water enters into chemical combination with the cement. However, since the most important use of water is to hydrate the cement, it would be much better to consider that concrete is a mechanical mixture of coarse aggregate, fine ag-

gregate and cement paste.

We were told many years ago that the more cement we used the stronger would be the concrete, and the results of so-called compression tests on cubes and cylinders were quoted to prove the truth of that statement. As a matter of fact, the so-called compression tests are more properly shear tests, and by varying the shapes and dimensions of the test specimens we can obtain greatly varying results. For example, testing a cube will give results 20% to 30% higher than the same concrete tested as a cylinder having a height twice the diameter. It follows, then, that all that can WILLIAM J. ANDERSON

Consulting Engineer, West Hartford, Conn.

be deduced from such tests are comparative figures which may mean little. It is more than likely that, when testing briquettes in tension, an increase in cement does increase the tensile strength, but—cement is not designed to take tension.

Effects of Sand Bulking

For over fifty years, we have known that sand bulked due to moisture and that in some cases this bulking could be as much as 40%, or more. We know also that fine sand bulks more than coarse sand with the same percentage of moisture. All that has been done is to recognize that there is a certain amount of moisture present in the "bulked" aggregate and to allow for this moisture in computing the total amount of water to be used. The fact that bulking makes it necessary to use a greater amount of cement and paste does

not appear to have been recognized.

Let us see what happens in a sand having a SG (specific gravity) of 2.63 and a dry loose weight of 98 lbs. per cu. ft. when it bulks 25% with 5% moisture.

One cu. ft. of dry sand with a SG of 2.63 would weigh 62.4 lbs. x 2.63 or 164.11 lbs., if there were no voids; but as there are voids, the dry sand weighs only 98 lbs. There has been a loss in weight due to the voids of 164.11 - 98.0 or 66.11 lbs., which represents $66.11 \div 164.11$, or 40.28%. Therefore the voids in the dry sand are 40.28%.

When this sand contains 5% moisture and bulks 25%, it occupies 1.25 cu. ft. and contains not only the 98 lbs. of sand but an additional 4.9 lbs. of water, so it now weighs 102.9 lbs. One cu. ft. of this bulked sand now weighs $102.9 \div 1.25 = 82.32$ lbs. made up of 78.4 lbs. of sand and 3.92 lbs. of water.

Since there are now only 78.4 lbs. of sand in 1 cu. ft. the new voids must now be $(164.11 - 78.4) \div 164.11$, or 52.22%. This is an increase of about 12% over the 40.28% voids in the sand when it is dry. It now requires $12.0 \div 40.28$ or

29.79% additional cement paste to fill these extra voids, or about 30% more cement

As some one may state that the moisture accounts for this additional 12% of void space, it should be realized that 3.92 lbs. of water occupies only 0.063 cu. ft. which is only 6% of the volume rather than the 12% so that even with the moisture present, there are additional air voids.

In order to absorb the moisture which causes the bulking, it is necessary that additional cement be used. The moisture film on each sand particle separates the particles and when the cement combines with this moisture, the grains of sand are separated, not by moisture, but by cement paste. So the bulking becomes permanent.

Ever since power mixing was introduced, we have held to the pracment and an increase in concrete strength can be obtained by a change in our method of mixing.

As the voids increase due to the bulking of the sand, it follows that the particles of sand are no longer in contact, but are separated by a film of paste made up of cement and water. The compressive strength of the mortar of sand and cement paste then cannot be greater than the compressive strength of the paste. Since the strength of the paste is dependent on the water/ cement ratio, the quantity of water used determines the strength of the concrete mixture. If this is always to be true, why bother about obtaining excellent sand and coarse aggregate, as a chain is only as strong as the weakest link, which in this case is the cement paste.

I believe there will be no argument against the following state-

ment: If the amount of paste (water and cement) is not in excess of that required to fill the voids in the sand, then the grains of sand are in contact and the strength of the mortar is dependent on the crushing strength of the sand and is independent of the crushing strength of the cement paste. It is not always true then that increasing the cement factor increases the strength.

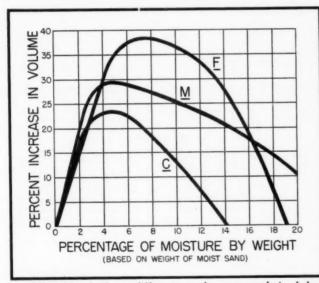
The sand and coarse aggregates being inert materials are not affected by the water, except that the sand bulks. The most important reason for the use of water is to hydrate the cement and as this requires only about 2½ gals. per bag of cement, any greater volume than this tends to reduce the strength of the paste.

How Much Water?

Let us see what would be the largest amount of water we could combine with cement and still have the particles of cement remain in contact so as to provide the strongest paste.

Portland cement, by specification, must have a specific gravity of not less than 3.10 nor more than 3.15 or a specific surface between 1.750 and 2,000. Assume the specific gravity is 3.12; and that one bag weighs 94 lbs. and occupies 0.95 cu. ft. If there were no voids in the cement. one bag containing 0.95 cu. ft. would weigh 0.95×62.4 lbs. $\times 3.12 =$ 184.95 lbs. The bag, as packed, weighs only 94 lbs. so there is a loss of weight due to the voids of 184.95 - 94.0 = 90.95 lbs. which means that the voids occupy 90.95 ÷ 184.95 or 49.1%, from which the volume of voids in one bag of 0.95 cu. ft. equals 0.95 x 0.4917 = 0.467 cu. ft.

If more water is used than can be contained in the voids in the cement, the cement particles will no longer be in contact and a weak paste will result. The maximum



BULKING of three different sands; see analysis below.

tice of charging the mixer drum with coarse aggregate, fine aggregate and Portland cement, then adding water to the mass in the mixer drum and mixing for a minute or more. This standard practice invites the bulking of sand and cement because, even if the materials were surface dry when introduced into the drum, they must bulk when the water is added. My experience has been that this bulking amounts to about 25% in the sand in the average mixture and that a considerable saving in ce-

SIEVE ANALYSES OF THREE DIFFERENT SANDS

Percentages		Sand "C"	Sand "M"	Sand "F"		
	Retained on Standard Sieves	Potomac River Concrete Sand	Allegheny River Concrete Sand	Potomac River Asphalt Sand		
	1/4 Inch	1	0	0		
	No. 10	48	13	1		
	No. 20	70	24	7		
	No. 30	79	48	19		
	No. 40	83	68	31		
	No. 50	88	89	49		
	No. 80	93	97	70		
	No. 100	95	98	82		
	No. 200	97	99	92		
	Passing No. 200	3	08	8		

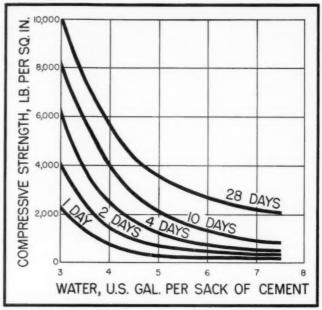
amount of water which can be absorbed in the voids in one bag of cement is 0.467 cu. ft. x 7.5 gal. or 3.50 gals. of water, which is 1.0 gal. more than is necessary to hydrate it.

We know from experience that fine sand bulks more than coarse sand with percentages of moisture by weight up to about 8%; and, strange as it may seem, Portland cement which is so much finer than the finest sand also bulks with small percentages of moisture. However, we have learned that sand when saturated (ie. the voids filled with water) does not bulk and neither does cement, so that the 3.5 gals, per bag indicated will just provide for saturation when 94 lbs. of cement occupy 0.95 cu. ft. If vibration and/or ramming is to be used, it is possible to reduce this quantity somewhat, as the voids would be reduced by the compaction, if heavy enough and sufficiently prolonged.

Using Surface Dry Sand

I have in mind the use of surfacedry sand and the preparation of the paste, or mixture of water and cement, in a separate small mixer, with vertical paddles, similar to those used for mixing mortar. The properly determined amounts of coarse aggregate, sand and paste, are then introduced into the regular mixer drum and mixing and depositing follows present standard practice except that no water is added to the ingredients while in the mixer drum. The amount of water to be combined with the cement when making the paste in the small mixer is only that amount necessary to fill the voids in the cement which has been shown to be about 3.5 gals. per bag.

McMillan, in Basic Principles of Concrete Making, gives curves of water/cement pastes which shows strengths up to 10,000 lbs. for pastes having a water/cement ratio of 3 gals. per bag. In the 1947 Proceedings of the Highway Research Board, in an article by Powers of the Portland Cement Assn., the statement is made that cylinders of a paste containing only 0.08 gram of water per gram of cement, molded under pressure, strengths as high as 40,000 lbs. per square inch. This figure is too high to expect under field conditions but with proper proportioning, the preparation of paste as a separate operation, and compaction after placing. I believe that strengths of from 8,000 to 10,000 lbs. can be ob-



RELATIONSHIP of water-cement ratio to cement paste strength.

tained economically rather than the 3,500 lbs. to 5,000 lbs. now being obtained.

A few years ago at a meeting of the Highway Research Board, the statement was made that concretes having water/cement ratios below 4.5 gals. per bag were undamaged by alternate freezing and thawing tests. If that is correct, this concrete which I propose would be immune to such damage since the water/cement ratio is less than 4.0 gals. per bag of cement.

If coarse aggregate and surfacedry sand are mixed in proper proportions with the proper quantity of cement paste, separately prepared and added to them, with no additional water, a concrete will result, which will not segregate, while being transported; can be readily placed in forms; will develop very great compressive strength; and will be immune to freezing. However, it should be compacted by vibration and/or tamping for best results. This tamp-

ing should be of the order of approximately 300 lbs. per square inch. The resultant strengths should be 8000 lbs. or more in 28 days.

There is no need for considering fineness modules of aggregates or surface areas, since if the aggregates and cement particles are each in contact, thus providing minimum voids in each, the simple act of filling these voids, insures that the surfaces are coated. It should be realized that it is possible to coat all the surfaces of the aggregates and still not have all of the voids filled, and as a result have porous concrete.

As it is not always possible to include in a concrete mix the maximum amount of coarse aggregate, because of spacing of reinforcing steel or for other practical reasons. the strength of this concrete is predicated on the strength of the mortar, which is made up of sand and cement paste.

Let us take a sample concrete mix, included in one of the bul-

TABLE 1-FORMULA YIELD IN CUBIC FEET

Stone 1,969 lbs.÷170.35 lbs.=11.5585 cu. ft. abs. vol. % af yield 42.91% Sand 1,248 lbs.÷164.11 lbs.= 7.6047 cu. ft.. abs. vol. % of yield 28.24%

Cement 537 lbs.÷195.94 lbs.= 2.7046 cu. ft. abs. vol. % of yield 10.04% Water 316 lbs.÷ 62.40 lbs.= 5.0641 cu. ft. abs. vol. % of yield 18.80%

Total Yield-26.9319 cu. ft. (say 27.0 cu. ft.) 99.99%

letins put out by one of the associations having an interest in the making of good concrete. These quantities are supposed to provide 27 cu. ft. of concrete having a strength in 28 days of 3,500 lbs. per square inch. Voids have been computed from the SG given and the weight per cu. ft. loose measure, stated for each ingredient in a surface dry condition.

Cement: SG = 3.14; wt. per cu. ft. at absolute volume = 195.936 lbs; 1 bag = 0.95 cu. ft. wt. per bag at absolute volume = 186.139 lbs; 1 bag weighs 94 lbs. per cu. ft. as packed in bags; $94 \div 0.95 = 99$ lbs.; voids = $(186.139 - 94.0) \div 186.139 = 49.5\%$.

Sand: SG = 2.63; wt. per cu. ft. at absolute volume = 164.112 lbs; weight per cu. ft., loose vol., surface dry = 98.0 lbs; voids = (164.112—98.0) \div 164.112 = 40.28%.

Stone: SG = 2.73; wt. per cu. ft. at absolute volume = 170.35 lbs; weight per cu. ft., loose measure, = 95.6 lbs; voids = (170.35-95.6) \div 170.35 = <math>43.88%.

Water: SG = 1.00; weight per cu. ft. = 62.4 lbs.; gals. per cu. ft. = 7.5.



• EVEN a "dry" mix (w/c ratio about 0.45) shows water on surface.

The batch weights for 27.0 cu. ft. of concrete are given as follows: Broken stone 1,969 lbs.; sand 1,248 lbs.; cement 537 lbs.; water 316 lbs.; or a total weight of all materials of 4,070 lbs. or 150,74 lbs. per cu. ft.

Analysis of yields are shown in Table I, with absolute volumes in cu. ft. Since 316 lbs. of water represents 37.93 gals., and 537 lbs. of cement represents 5.712 bags, the water/cement ratio is 37.93 ÷

5.712=6.65 gal. per bag; and, according to McMillan's table, such a paste would give about 2,500 lbs. strength in 28 days rather than the 3,500 lbs. stated. The sand/cement ratio is $1.248 \div 5.712 = 218.4$ lbs. per bag. Since the voids in sand were stated as 40.28%, the volume of sand at 98 lbs. per cu. ft. should be $(0.95 \times 98) \div 4028 = 231.1$ lbs.

The computed figures showing percentages of the absolute volume of each ingredient as compared to the total yield is of interest as it shows that the stone makes up only 42.91% of the bulk, the sand 28.24%, the cement 10.04% and the water 18.8%.

Further study of the absolute volumes, show that the voids in each of the ingredients when made up as concrete are as indicated in the computations below.

Voids in Stone-Since the total yield of concrete is 26.9319 cu. ft., the stone being the largest contributor to volume must be dispersed through the mass so that it now has a gross volume of 26.9319 cu. ft. It's absolute volume was only 11.5585 cu. ft. so the voids in the stone must be 26.9319-11.5585 or 15.3734 cu. ft. which would make the voids in the stone 15.3734 ÷ 26.319 or 57.08%. Originally the stone with particles in contact, contained only 43.88% voids so the voids have increased 13.20% for the whole mass and the particles are not in contact.

Voids in Sand—As the sand, cement and water have to make up the remainder of the total volume, this volume is 26.9319 — 11.5585 = 15.3734 cu. ft.

The gross volume of sand must then be 15.3734. However, the absolute volume of the sand is 7.6047

MEASURE FILLED BY SHOVELING MEASURE FILLED BY POURING 150 VOLUM SAND 140 0 130 130 PERCENTAGE COARSE SAND AND MEDIUM SAND 120 DRY BULKING 10 INUNDATED NUNDATED POUNDS 32 ONE UNDATED 36 SQION SAND. Z SAND 44 0 95 WET TAGE DRY 8 9 RCEN 52 OF FOOT 75 WEIGHT 56 CUBIC 60 12 **PERCENTAGE** OF MOISTURE

EFFECTS of various moisture contents on volume-weight of sand.

(Continued on page 92)

FUNDAMENTAL REQUIREMENTS For A Good Sanitary Fill

This is a portion of a paper by Robert L. Anderson, Superintendent of Public Works and Village Engineer of Winnetka, III., before the League of Minnesota Municipalities.

THERE are really only two fundamental requirements for a good sanitary fill—good compaction and prompt, adequate cover. But to accomplish this under all weather conditions, without delay to trucks delivering refuse, under varying soil and site requirements and without nuisance from blowing papers may require a bit of doing.

The principal requirement is adequate equipment operated by trained, conscientious personnel. Next a general plan of operation must be sketched, taking into account topography, prevailing winds, availability of cover material, drainage and the like. Then a routine must be worked out for systematic handling of the traffic and refuse delivered, based upon the characteristics of site, soil and weather.

In the case of very small operations labor requirements may be so little that a collector can handle the fill routine after completing his route and I know of a few cases where that is done successfully. But usually at least one regular man is desirable. It has been found that under most circumstances one man can readily handle all the refuse from up to 20,000 population if he is properly equipped and trained, in addition to caring completely for maintenance of his equipment.

The method is particularly well adapted to reclamation of waste areas—ravines, swamps and the like. But it may be worked equally well on level land and it is evident to me that the average town surrounded by farm land has ample opportunity for disposal sites even though it should be necessary to buy farm land. Later it could be sold again for the same use and the investment recovered if necessary.

Questions on Fill

To answer quickly a few questions that always arise:

Any type of soil can be used.
 Sandy soil works most easily.

 Contamination of wells outside of the immediate vicinity is unlikely except in the case of fissured limestone underlying the site. 3. Flying papers are something of a nuisance, not wholly solved under adverse conditions of high winds. But they can be largely controlled by careful layout of the operation and erection of fences or planting of shrubbery shields, supplemented by a routine hand pickup patrol by the operator.

4. Flies and rats, fires and odors are entirely absent.

5. It is possible to operate a sanitary fill in close proximity to residential property without undue health hazard or nuisance, except for the truck traffic.

Winter Operation

Two aspects deserve special comment. The first is winter operation which has no doubt occurred to many as a serious problem. Experience shows that with a few precautions it will not give undue trouble. First, get equipment heavy enough to handle some frost. The amount of dirt handled each day is not large. Insulation with a deep layer of leaves, not packed down by equipment, will help in keeping frost out and has been a complete solution in my own case. Choice of a sandy well-drained soil will help. Preparation of an extra open trench to be used as a last resort and covered with snow or stockpiled earth is of insurance. In my own case where we use a drag-line for excavation my final shot in the locker is a frost-ball with which we can break up enough earth, although this has been used only once in five years.

Anticipating your concern about this feature I have written E. J. Booth, city engineer of Bismarck, N. D., where a fill has been operated through last winter. He reports no trouble although they had 36 degrees below zero. He says in his case dry sandy soil has been easy to work even though frozen, but suggests an open trench for the most severe weather if the soil is heavy and wet.

Access to Dump Face

The other item on which I want to comment is working out a routine to give uninterrupted access to the dumping face. In some operations mats may be necessary. However, I have worked out a system which is quite successful for an operation of not more than thirty or forty truck-loads a day. It is a little complicated to explain but very simple in operation.

The Winnetka System

In essence it involves dumping in trenches at right angles to a semipermanent road. The fill to a point 7 feet above original grade is made in two lifts, the first to an elevation just slightly above original grade. This is covered with a temporary thin layer of earth or cinders if available and acts as an access roadway for trucks to the face. After it has been constructed to the far end of the trench from the access road, the second lift is started, working back toward the road. The next trench is now opened by the dragline and the earth placed in final position in one operation. The dry compacted fill in the trench provides a usable roadway in any weather, even though we are operating in low land where water stands on the ground at times. We've never been out of operation for a day.

This is only one method and there are many others possible, each best adapted to some set of conditions. Flexibility is one of the major advantages, with the only essentials compaction and cover.

Refuse Disposal in a Metropolitan County

SAN DIEGO County, Calif., provides refuse disposal sites for rubbish and trash for both the incorporated and unincorporated areas. The Construction and Repair Div. of the Dept. of Public Works is responsible for the location and maintenance of these sites. There are three basic patterns of operation: 1-The County owns or leases the land and maintains it with an employee of the department; or 2-The County leases the land and the lessor agrees to maintain the fill; or 3-The County contracts with an individual to maintain it for salvage rights. In 1951 there were 18 public dumps and negotiations were in progress for two more. The department regulates and licenses all trucks used for the collection and disposal of garbage and rubbish.

MACHINES

DO THE WORK FASTER AND CHEAPER



GETTING THE JOB DONE AT A PRICE YOU CAN

OUR BUSINESS district has been kept free from snow by a John Deere MI tractor equipped with a 6-ft. snow bucket with Walker loading attachment, and without hiring additional help. An extra truck was used if ours was plowing snow. The tractor has also helped on other work as we have the bulldozer blade and sand bucket as accessories. — Thomas Murray, City Superintendent, Otsego, Mich.

ON A WATER main job, our contractor used a concrete saw to cut through pavements, resulting in very satisfactory work.—George G. Schmid, City Engineer, Royal Oak, Mich.

WE BOUGHT a Case tractor with Lull loader last year. It has proved a most versatile piece of equipment. We have used it for loading sand, soil, gravel, snow and leaves with it; and it also gives us a small crane or lifting device which has been useful.— E. G. Moody, City Manager, Fremont, Mich.

OUR MOST VALUABLE piece of equipment is a Sherman digger mounted on a Ford Tractor. This was bought last year. We used it to dig trenches in places where we cannot put a larger machine, for laying short lines of small pipe and for digging sewer manholes, etc.—Lon J. Embree, Sup't., Water & Sewers, Magnolia, Ark.

OUR DODGE POWER wagon, with front winch, is one of our handiest tools. Equipped with a movable front boom, it is used a lot to lay and load pipe. It is big enough to pull a trailer with our Model 95 Cleveland ditcher on it.—C. T. Porch, Sup't. Light & Water Dep't., Alexander City, Ala.

OUR MOST effective equipment have been Flexible sewer rods, which we use for all of our sewer cleaning work. They can't be beat on any size job.—W. Coy Stephenson, Sup't., Water & Sewers, Hartselle, Ala.

EQUIPMENT USED in constructing a water line of 12-inch and 16-inch cast iron and steel pipe 21 miles long, of which 14½ miles are completed, included: A Cleveland 140 trencher; a Bucyrus-Erie 15B backhoe; International TD18 and TD9 dozers; International TD9 swing cranes; LeRoi 210 and Worth-



 UNITS used by the City and County of San Francisco, S. P. Duckel, Dir. of Public Works. Left, sewer cleaning unit; below, truck unit for crack-sealing pavements.

SNOW REMOVAL was performed most effectively using our own trucks with both underbody blade and front end plows; an Austin-Western grader; Hough Payloader; and Tarrant Scotchman and Burch chip spreaders for applying salt. An intensive preventive maintenance program on all vehicles and equipment and a reorganization of plowing schedules made this efficiency possible.—George E. Snyder, City Engineer, East Lansing, Mich.



ington 105 compressors; Ingersoll-Rand jackhammers, spades and breakers; a Southwest ripper; and White, International and GMC trucks, 2 to 10 tons.—G. A. Rhoads, Manager of Utilities, Safford, Ariz.

A BANTAM backhoe was rented to dig trenches, unload pipe from cars, unload trucks, set fire hydrants and do similar work on our water line construction. An I-R compressor furnished air for caulking.—Myron J. Linebarier, Manager, Camden, Ark.

A NEW WATER project and another project for a sewer collection system are now coming up. Just now, we are completing the installation of a Nordberg radial diesel of 1.170 kw in our power plant.—Robert A. Fricke, City Superintendent, Zeeland, Mich.

FOR DIGGING trenches and for cleaning dirt off the street, our Payloader, with backhoe, is indispensable.—R. M. Magnus, Chief Draftsman, Water. Gas and Sewage Disposal Dep't., Duluth, Minn.

by the Road Research Laboratory of the Dept. of Scientific and Industrial Research of Great Britain. Two weights of tractors were used. One weighed 12,840 lb., with 15-in. tracks, giving a total contact area of tracks of 1764 sq. in. The other weighed 24.164 lb., had tracks 20 in. wide with a total contact area of 3360 sq. in. The soils on which the tests were made included gravel, sand (79% sand), silt and clay. A test consisted of 32 passes over a given area of soil. The results were compared with those from a similar number of passes of an 8-ton smooth-wheel roller and of a 12-ton pneumatic tired roller. The degree of compaction obtained was determined by measuring the dry density of the compacted soil; employing the sand-replacement method, and using the mean of ten observations for each test.

The dry densities obtained on heavy clay were: 96 lb. per cu. ft. by the lighter tractor, 99 by the heavier tractor, 96 by the smooth roller, and 98 by the pneumatic tire roller.

In a gravel-sand-clay soil, the lighter tractor gave a density of 127 lb.; the heavy tractor, 124 lb.; the smooth roller, 138 lb. and the pneumatic tire, 126 lb. The air voids by tractors and rollers in heavy clay were almost the same in all cases. In the gravel-sand-clay, the voids were 9 by the lighter tractor, 11 by the heavier, 2 by the smooth roller, and 10 by the pneumatic tire.

Commenting upon the results, the Laboratory report says:

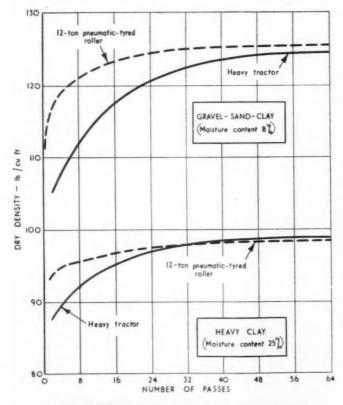
"Although the tractors produced a satisfactory state of compaction with all the soils tested when at their average natural moisture content in the British Isles, a large number of passes was required to obtain this compaction. The investigation thus showed that the use of track-laying tractors solely for compaction purposes is not likely to be economic and that equipment especially designed for soil compaction should be employed for this work. The only case in which tractors might be used economically is for small areas of soil where the introduction of additional plant would not be worth while.

The results also indicate that the state of compaction produced by a heavy tractor towing a 12-ton pneumatic-tired roller would be determined solely by the performance of the roller on the two soils tested. These results are likely to apply to soils generally."

Compacting With Track-Laying Tractors

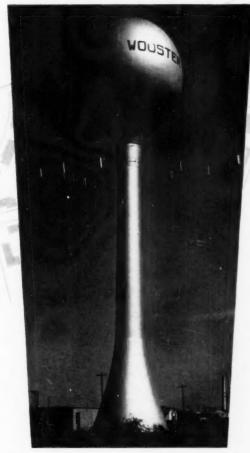
TRACK-LAYING tractors, either traveling alone or with bulldozer blades, hauling rollers, etc., produce considerable compaction in fills, and the question arises how

effective this is and to what extent it can be relied upon in helping to produce the compaction desired. A study of this has been made and scientifically conducted tests made



RELATIONSHIP of dry density and number of passes.

What Makes a Municipality Modern



This 150,000-gallon Horton Watersphere installed by the Harris County Fresh Water Supply District No. 2 at Wooster, near Baytoun, Texas, has increased the water pressure from a previous maximum of 35 lbs. per sq. in. to a maximum of 55 lbs. per sq. in. in the Harris County distribution system.

Is it the homes? The transportation facilities? The people? Yes, it's all of these plus one very important factor... an up-todate water and sewage system. A water and sewage system that satisfies the needs of the community, furnishes adequate fire protection, and allows for municipal expansion.

The Horton Watersphere has played an important role in improving many municipal and private water systems. Basically, the Watersphere is a welded steel elevated tank providing the inherent advantages of an elevated water supply—more uniform water pressures and lower pumping costs. Built in standard capacities from 25,000 to 250,000 gallons, it provides a reserve for peak load periods that flows back into the mains by the force of gravity alone.

In addition to its utilitarian value, a Watersphere presents a pleasing streamlined appearance. Other Horton elevated tanks are available in standard capacities from 5,000 to 3,000,000 gallons. Write our nearest office for quotations. State capacity, location and height to low water line.

HORTON

WELDED STEEL
STORAGE TANKS

CHICAGO BRIDGE & IRON COMPANY

Plants in Birmingham, Chicago, Salt Lake City, and Graenville, Pa.

Les Angeles 17 1508 General Petroleum Bidg. New Yerk 6. ... 3316-165 Breedwey Bidg Philadelphia 3. 1648-1700 Walnut St. Bidg Sam Francisco 4. ... 1525-200 Bush St Seattle 1. 1339 Henry Bidg Tulso 3. ... 1841 Hunt Bidg Washington 6, D. C. 1120 Cefriz Bidg

A Clinical Report:

OHIO WATER RESOURCES

A "clinic" on Ohio's water resources was held recently, the first of a proposed annual series of inquiries into the subject. C. V. Youngquist, chief of the Division of Water, Ohio Department of Natural Resources, applied the dictionary definition of clinic to the gathering: "Instruction of a class by treatment of patients in the presence of pupils.

The "patient" in this case was the supply of water for all purposes in Ohio, and, by extension, in much of the United States. The twenty reports covered the technical aspects of locating, conserving and purifying water and applying it for various purposes, and the legal and moral aspects of preventing its pollution and assuring its continued availability. Representatives of chambers of commerce, manufacturing companies and the utilities were the "pupils." Sponsors were The Ohio State University, Battelle Memorial Institute, the Ohio Chamber of Commerce, and the Ohio Department of Natural Resources. The papers will be published by the Engineering Experiment Station of Ohio State University.

Contrary to popular impression, the prognosis is generally favorable. In Ohio, and in other parts of the nation where conditions are similar. no persistent long-term trend toward water famine is evident, even though there are cycles of drought and serious local shortages, particularly where the demand for ground water is greater than the supply. The problems are those of finding new supplies and of making the fullest use of known resources, including conservation to make what is available go further.

Farming and Water

Bigger crops result in forcing more water through vegetation and into the atmosphere. This water is "used up." It does not perform several tasks, like the water used for

cooling purposes- except as it gets into the hydrologic cycle of evaporating, falling as rain, circulating, and evaporating again.

A. W. Marion, director of Natural Resources of Ohio, gave figures on the water used by crops. Growing a bushel of corn takes 20 tons of water. Wheat takes 30 tons per bushel, soybeans 36 tons per bushel, alfalfa 850 tons per ton. To grow the crops raised annually in Ohio takes over eight billion tons of water, much of it in July and August, when rainfall is lowest. The plants use water stored in the soil.

Irrigation is usually thought of as a western activity, but it is increasing in the east. For irrigating greenhouse crops, potatoes, fruit, nursery and other specialties, Ohioans pump over three billion gallons of water a year. Almost fifty thousand acrestwo thousand under glass-are irri-

In places, and at certain seasons, surpluses of surface water must be dealt with. Private and public drainage projects in Ohio represent an investment of more than 160 million dollars. The 46 million sections of tile Ohioans laid in 1949 would make a drain about 9000 miles long.

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One reason water shortages crop up in many places is that increasing population and industrial expansion make excessive demands on established supplies that formerly were adequate. Information on the use of water in industry came out of a plant-by-plant survey in the Lake Erie basin section of Ohio, an area that contains 41 percent of the state's population. The total industrial use averages nearly four billion gallons a day, or about 1,200 gallons per person. Only a small amount of this water comes from underground. Most of it is temporarily removed from Lake Erie and tributary streams, made to serve its function in industry, and then returned to resume its flow toward the St. Lawrence. Domestic use in the same area is about 150 gallons per capita per day.

Of the water that falls on Ohio, averaging 38 inches per year, about two-thirds is used by vegetation and is evaporated; and about one third (13 inches) runs off, mostly during flood periods. That used for daily living and for industry is only a small part of the total-about one inch per year.

The needs for water are likely to

grow. The only way they can be met is by proper use of the supply, since this cannot be basically increased. It is interesting that "rainmaking" by seeding clouds to make them yield more was not even mentioned at the clinic.

In a review of the history of municipal water supplies, F. H. Waring, chief engineer of the Ohio Department of Health, stated that 486 separate water supply systems serve 598 municipalities containing nearly six million people, or about threefourths of Ohio's population. Chlorination is "universal" and 223 treatment plants furnish water to 324 municipalities containing nearly five million people.

Over half of the water used by industry is for cooling. In Ohio, the steel industry is the largest user; next comes petroleum refining; and then electric power generation. Almost any industry can have big water bills. A small electroplating plant may use 200,000 gpd. The General Motors plants buy or pump a total of 31/2 billion gallons a month at a cost of nearly \$400,000, or about 3 cents a ton.

Getting suitable water is only one phase of industry's problem. Im-

purities may cause serious losses. For instance, installing ion-exchange units which produce water free from contaminating minerals reduced rejections for cracked insulation at a spark plug plant from 6% to 0.3% and saved about \$1,300 per

Water Fit for the Next User

Industries and communities that release water after their temporary custody of it are bound by duty and by law to pass on this resource in something like as good condition as it was when received. A large part of the water problem is prevention of pollution.

Attention to this problem is greater than ever before, and acceptance of responsibility is growing. E. J. Cleary, chief engineer of the Ohio Valley Water Sanitation Commission, cited inquiries in Maryland, Pennsylvania and Kentucky as proving that fears lest industry will avoid and withdraw from states that establish requirements for restoring water are unfounded. Uniformity and fairness in requirements and enforcement will give all states an equal chance in holding their factories and getting





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new ones. Enlightened industries accept their responsibility for taking care of water, assume the extra cost as part of the expense of doing business, and show their preference for communities that insist on decency in caring for water resources.

Disappointments and Progress

A speaker from a large Ohio steel company reported on a number of projects, some of which proved out well in the pilot-plant stage after successful development in the laboratory, but fell down on economics. Getting rid of the acidity of water used in pickling steel has been one of the disappointments; useful and profitable by-products haven't yet materialized. Neutralized slurry is stored in large lagoons at a cost of more than fifty cents per ton of steel pickled, an economic incentive to solve the problem. A project to eliminate the last fraction of phenol from coke plant wastes has proved more successful. By chemical oxidation the phenol content of the waste water is reduced to practically

Another great source of water contamination is the acid drainage from coal mines. When air gets to them, the iron pyrites and other sulfur compounds in the coal are oxidized and the resulting products convert the water draining from the mines into dilute sulfuric acid. Elaborate WPA projects were set up to seal abandoned mines on the theory that when the oxygen in the air was used up, the mine drainage would lose its acid. The method was not successful, apparently because too much oxygen still seeped in. Getting water out of mines with the least possible exposure to the sulfur compounds helps. Alternatively, if abandoned mines are low enough, air may be excluded by complete flooding. In strip mining, the sulfurbearing material should be packed under impervious clay, or, if conditions are right, kept under water.

Underground water, because it is clear and cool, is a great industrial asset. In parts of the United States, more has been drawn out than nature puts in, thus giving rise to the rumors of a "falling water table." In Ohio there is as yet no serious overpumpage except in the Mill Creek Valley at Cincinnati. Modern prospecting methods, including the electric logging developed in exploring for petroleum, show the location and extent of underground water resources. These scientific ways to locate water have proved the fallacy





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of "witching" or "dowsing," which curiously persists in many places, even to the extent of being used by some industries.

Pumping down underground reservoirs so they can be recharged greatly increases the total supply of water that is available. Much of this recharge is "natural" because water infiltrates into the aquifer from nearby streams. The process is exactly like drawing down a surface reservoir in dry times so that it will have capacity to hold water when rains come. Some recharging is done artificially, by injecting water through wells or spreading it on the ground. In Long Island, recharge of water has been compulsory for nearly 20 years. Water levels have stayed well up, though in certain areas temperatures have risen considerably.

Balance Sheet

Assets of water, like financial resources, must be kept in balance. In the long run, as much of this liquid asset must be returned as is taken out; otherwise a deficit will be created. As in finances, nothing is gained by hoarding. Activity in deposits and withdrawals makes for a high-level economy. For Ohio, a

balance sheet was presented by C. G. Paulsen, chief hydraulic engineer of the USGS. Inventories to date show that, in general, Ohio has a favorable balance of water assets. This must be maintained by measuring the flow in streams, by developing storage possibilities and by discovering and conserving underground supplies.

Solution of the water problem requires knowledge and enlightened community action. Few such projects are spectacular; most of them

consist of the carrying out of many details. The overall supply of water in Ohio, and in much of the remainder of the United States, is greater than any demands now in sight. Scientific measurement and the application of proper conservation measures will forestall most troubles due to local and temporary shortages.

This article, with slight editorial modifications, is from a report by the Ohio State University Research Foundation.

GROUND-COVER PLANTS FOR ROADSIDE EROSION CONTROL

THE proper type of planting for erosion control along highways is discussed quite fully in a report of the Highway Research Board's Committee on Roadside Development. Such planting is determined largely by site conditions. While turf is often most desirable, the soil, the drainage, the degree of slope or adjacent plant growth may indicate that woody ground cover is more practicable or suitable. This

is likely to be the case where the slope is greater than 1 on 2, where the soil is sterile or rocky, where turf maintenance would be costly or difficult, where the wooded character of the locality calls for similar harmonious growth, or where traffic direction and control can be aided.

"Ground cover" is defined as lowgrowing herbaceous or woody plants not more than 3 ft. high at



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. . . You'll want to conserve its use. You'll want to employ it to the best advantage and according to the best accepted practices. Here we show a few ways that will help you accomplish these purposes. You might like to check these operations against your own practices.

Fig. 1. Cutting Pipe with 3-Wheel Cutters

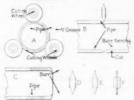


Fig. 2. Cutting with Hacksaw



Fig. 3. Standard Pipe Thread

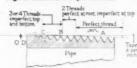
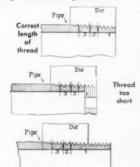


Fig. 4. Correct Length of Thread



Thread too long



Note these suggestions:

Cutting pipe with 3-wheel cutters (Fig. 1. At "A" pipe is about half cut through. At "B" a bit forming. At "C" note how deeply bur extends the pipe thus reducing I.D. Produced by badly showed cutter, like "D". Also too thick. "E" shows a superior cutter, which cuts thinner, easier and quicker, and leaves smaller burr. Thin blade wheel (shown at "P" with knurled instead of knife edge) does not spread metal apart, but makes clean square cut.

Cutting with hacksaw. Make cut few inches from vise to prevent vibration. Hold saw blade perpendicularly and at right angles to pipe horizontally. Improper cuts mean needless waste of pipe and time

When threading pipe, pull tool easily and steadily; don't jerk or yank.

In running up dies, the most important thing is to know when to stop and reverse them. All threads must be run long enough to obtain 5 or more perfect threads to insure a thorough and full metal-to-metal contact when threads are screwed "home" in their fittings.

Reaming is necessary (Fig. 5). The pipe-end at "A" has a reamed edge with no interior projecting burn to interfere with flow. Pipe-end at "B" has heavy burr, which projects well into pipe, reducing its bore greatly, thus preventing delivery of water at full capacity. Burr should be reamed out.

Use proper wrench. In screwing up fitting on pipe or nipple, it is advisable to use monkey-wrench, which has smooth jaws. Never use a teeth-gripping wrench, whose teeth can cut into bands of fittings and reduce their strength.

Bending pipe. When it is necessary to bend pipe, either use softer material or soften the section to be formed by heating to a red heat. Bend a little at a time over rounded wood block, or anything round and soft. Do not bend over sharp edge, or pipe will kink.

Choose good pipe first. Care makes it last.

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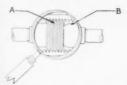


Fig. 6. Kind of Wrench to Use

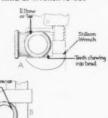
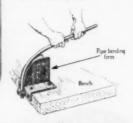


Fig. 7. Correct Screwing-up



Fig. 8. Bending Pipe





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maturity. Such plants include shrubs, vines, grass, sod-forming perennials and ferns.

A properly rounded cross-section is a prerequisite for successful erosion control and use of ground covers. Specifications to provide such cross-section should be included in the original contract. Before grading begins, provision should be made to retain desirable existing growth and this may limit the extent of slope flattening and rounding. If topsoil is needed, it can usually best be obtained from areas disturbed by construction.

Selection of Species

In general, existing growth is a reliable index to the appropriate species of ground cover to use. Native species generally deserve preference over introduced species, and plants should be chosen for their ability to thrive under existing conditions of soil, moisture, and exposure.

The ground covers most valuable for preventing erosion are thicket or mat-forming plants, those that root from decumbent branches and those that spread from suckers or shoots. Bushy dense-foliaged plants, including some evergreen species, afford the greatest soil protection
against wind and rain, as do plants
producing the most litter with the
greatest water-holding capacity.
Rapid-growing species deserve
preference over slower-growing
species, since they give protection
faster.

Plants resistant to fire or those with an ability to sprout after burning or cutting permit retention of a cover otherwise easily destroyed. Plants with inconspicuous flowers or fruit are less subject to vandalism and do not divert the driver's attention.

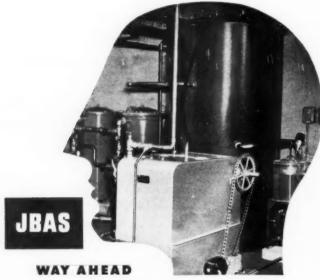
Plants to avoid are those subject to insect damage or disease, or those that are secondary hosts to such diseases and insects; plants so vigorous and aggressive in growth that they crowd out more desirable species or become a pest to agriculture; and plants poisonous or irritating to the skin of man.

The height and contrasting texture of ground covers can often implement traffic direction and separation without conflicting with sight distance. For medians and intersection islands, desirable species are those that are: adaptable to the site and available at reasonable cost: long-lived, yet can furnish the required cover in a reasonable time: able to endure occasional foot or vehicular traffic and possess quickrecovery characteristics; neat in growth habits; not likely to increase fire hazards; harmonious with native species growing in the area; low enough in ultimate height not to restrict sight distance or cause snow drifting; and resistant to disease and insect injury.

Delivery and Planting

Nursery-grown stock is more easily handled and generally more satisfactory than collected stock. Competent personnel should supervise all digging and handling operations, including the heeling-in of collected plants. Holding plants over increases costs and decreases the percentage of survival, but this practice is sometimes necessary to salvage desirable species.

Rigid inspection and careful handling of nursery-grown or collected stock are essential during digging and at the point of delivery. Only healthy plants with adequate root systems should be used. Care should be exercised during transportation and planting to avoid drying out of root systems. Each crew should have at least a skeleton force of experi-



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To conserve moisture and minimize weed growth, plants should be mulched by covering the bare soil with a minimum of 2 or 3 in. of loose straw, hay, pine needles, or other available material. growth should be pruned to balance root growth lost during transplanting; for vines and fast growing shrubs, cutback should be more severe, leaving only the first two or three basal buds. Rain cups or trenches will retain surface water for even distribution to the plants. Unless optimum soil-moisture conditions exist, a thorough watering is advisable after planting.

Maintenance

The initial cost of planting shrubs and ground cover will exceed the cost of seeding in most cases. Maintenance also will probably cost more during the longer period of establishment. However, once a complete cover is obtained, the maintenance of properly selected species is almost nil, except for the occasional removal of certain debris which may collect in such quantity as to be a nuisance

The maintenance normally needed for a minimum of two growing seasons after planting includes regular watering during periods of drought; keeping rain cups or trenches in good repair; keeping mulch in place and to adequate depth around plants; cutting tall weeds in spaces between planted shrubs or vines; and careful mowing of grass and weeds in adjacent areas to encourage the spread of the planted ground cover.

Precautions should be taken against fire. A half an inch of loam placed on dry mulch materials is a precaution both against fire and against displacement of the mulch, particularly adjacent to the travel way. Clean, well-mowed shoulders and shoulder slopes are further insurance against fire.

A list of recommended ground cover plants for the various sections of the country, and a bibliography are included in the original, which is listed as circular 166 of the Highway Research Board.

111 New Sewage Treatment **Plants**

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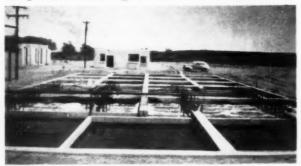


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Skid Resistance on Different Surfaces

MEASUREMENTS of skid re-sistance on more than 50 different road surfaces in California. were reported last year to the Highway Research Board. Most of these were made by the truck-trailer method, at speeds of from 10 to 50 mph, and with three types of tires -synthetic rubber with a non-skid tread pattern, and with tread worn smooth, and natural rubber with a non-skid tread. Some of the effects of various surface structures and conditions on skid resistance are described briefly below.

Asphalt surfaces were classified as: 1-those with angular aggregate used as cover material; 2-with rounded aggregate as cover material; 3-with excess asphalt causing bleeding and a glazed surface. Whether the surfaces were wet or dry, the friction values of the different types were in that order, with those on wet pavements one-half to one-third those on dry. On bleeding asphalt surfaces, the friction when wet was dangerously low, less than a third that on the same surface when dry. Values for round aggregate were about 25% lower than for angular aggregate; suggesting that rounded gravel be not used for cover without being crushed.

Comparing open-graded with dense-graded construction, it was found that, in the wet tests, the friction of the open-graded angular aggregate was 10 to 25% greater than for the dense-graded or for the open-graded with rounded aggregate. The angularity of the aggregate affects the friction more than the type of grading. Another advantage of the open graded surface, in rainy weather, is the complete absence of the splash experienced on all dense-graded surfaces.

"Taking all factors into account, an open-graded plant-mixed surface using properly graded angular aggregate up to 38 in. maximum size should provide high skid resistance, high stability, a smooth riding surface, and, if light colored aggregate is used, good light reflecting properties for night driving."

Portland cement concrete pavements, tested in the same way, showed friction values on new pavements only slightly lower than on asphalt pavements built with angular aggregate. However, as traffic wore off the sand grains and as the surface became coated with oil

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drippings, the friction coefficients dropped 20 to 25%. Washing the surface, as by flushing or heavy rain, is the only known method of improving the skid resistance of old concrete pavements. To develop maximum skid resistance, "it is desirable to develop a sandy texture in the final finishing operation, preferably by the skillful use of a fibre or wire broom."

Open-Grid steel bridge floors

gave higher friction values than any other surface type when dry, but only about one-fourth as great when wet.

Effect of Tire Type. Friction values for both synthetic and natural rubber tires with a rib tread were very nearly the same, with the former slightly the higher. Those for synthetic smooth tread were substantially lower than the others except on new cement concrete.

tion of light weight galvanized iron around the joint to form a space 1" x 6". Where the edges of this channel met the sponge rubber, they were coated with Tremco.

(6) The annular 1" x 6" space was filled with a mixture of fine sawdust and hydrated lime.

(7) Place a reinforced concrete band around the entire joint. In one case, $\frac{1}{2}$ " x 3" lead was placed around the pipe at the outside edges of the band which will allow caulking should this joint leak in the future due to the contraction of the pipe during low temperatures.

The repairs made to the 66-inch pipe in 1951 were carefully watched last winter and no leakage was detected. The method of repair on this pipe was different because the pipe is circular. The joints were caulked, carefully cleaned and covered with a layer of sponge rubber 10" wide. This was covered with a layer of rubber belting with feathered edges where the ends met. The whole was secured to the pipe with three flat steel bands, each band being made up of three pieces bolted together. Where the final tightening was done, usually near

REPAIRING LEAKY JOINTS IN THE WINNIPEG AQUEDUCT

EAKING joints in the 96-in.

pressure pipe of the Winnipeg
Aqueduct were repaired by the
procedures listed below, according to the 1951 report of the Winnipeg Water District. This pipe is of
a horseshoe shape with a flat V at
the invert. The pipe was poured in
place with a copper expansion joint
every 8 feet. Instead of each joint
moving slightly with expansion and
contraction of the concrete, all the
movement of perhaps ten joints
seems to take place at one point.
The repairs to these joints were

made to allow normal movement between the concrete band and the pipe. Methods used were:

Uncover pipe and caulk joint with lead wool.

(2) Level off as much as possible any inequalities in the line of the two pipes.

(3) Coat area with coal tar so that repair band of concrete will not bond to the pipe.

(4) Place two bands of sponge rubber, one on each side of the joint.

(5) Place 6" x 1" channel sec-

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the top, a piece of steel about 8" long, with feathered edges, was placed directly below the jointing point of the steel bands and above the rubber belting. When complete the whole joint was swabbed with coal tar and backfilled. At one of these repairs a temporary covering was placed over the hole to allow for inspection during the winter.

N. S. Bubbis is general manager of the Greater Winnipeg Water District.

Diatomite Filters For Swimming **Pool Installations**

Results of experimental work at the University of Florida Sanitary Engineering Research Laboratory indicate that diatomite-type filters have many advantages for swimming pools where the water being recirculated is of low turbidity. Experimental data now available warrants the approval of some makes of filters for swimming pools on an equality with rapid sand gravity or pressure filters. Efficient operation was possible at a rate somewhat in excess of four gallons per minute per square foot, and at this rate a sparkling clear effluent was produced, with the pool water maintained well within USPHS drinking water standards. On this work, an amorphous aluminum silicate powder was used in place of diatomaceous earth.

Hollow Sidewalks A Problem in Street Widening JOHN HUBEL

N connection with Milwaukee's street widening program, it was necessary to move back toward the property lines, narrowing the sidewalks. Many so-called hollow sidewalks, that is, sidewalks with storage areas under them, complicated the problem. These had to be filled in, if no longer of any use; or walled off by a retaining wall at the new curb line.

The hollow sidewalk is a privilege, the city, by permit, allowing the use of the underwalk space as an extension of the basement area. The permit is subject to cancellation at any time by the city council. Similarly, the property owners were required to pay for the cost of filling or otherwise modifying the area as required by the street widening program.

These underwalk areas were used,

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in the past, mainly for storage of coal; but with the advent of automatic heat, using oil or gas, many property owners no longer needed the space and were willing to have them filled. Some stores, however, preferred to pay the cost of modification in order to retain the storage space to accommodate their stocks of merchandise.

About 100 properties were involved in a recent street widening program on West Wisconsin Ave., and about a third of these desired to retain the underwalk storage space. In such case, the city installed

and the property owner paid for a retaining wall at the new curb line and for the filling of the area between the old and the new curb lines. For such filling, as well as for filling of entire underwalk areas, the city used bank run gravel. This compacted readily and did not settle, leaving low spots in the walk or in the street area.

Some of the property owners along Wisconsin Ave. refused to pay the cost of repairing and replacing the walks after modification. In other cases there was dispute between the owner and the tenant as to who should pay. In either case, the city policy was to do the work, after a reasonable time had been allowed the property owner for doing the work or for determining who should pay for it, and to charge the cost to the owner on the tax bill. Such action was necessary, because the sidewalk reconstruction work had to be done before the work of widening was started. During widening and repaving, there will be no place for walking except on the sidewalks; and if these are under construction at the same time, the street would have to be entirely closed.

In laying a new walk surface over that part of the sub-space after the retaining wall was set, it was found that two courses of concrete with a watertight membrane between them was necessary.

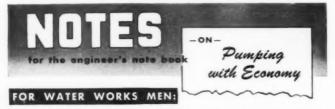
Rubber-Lining a Reservoir

The Dunlop Rubber Co., an English firm, is considering lining with rubber a reservoir 750 ft. long, by 300 ft. wide and 18 ft. deep. The reservoir was built over a coal mine. and settlements have occurred which caused fine cracks in the reservoir lining, which still continue to develop. It was thought a lining of rubber would be tough and extensible and absorb the slight movement which causes these cracks. However, the application of the rubber presented many problems; among them was the impracticability of fixing the rubber to the walls and floor with adhesive. The water engineers and Dunlop technicians have evolved a method which they expect to try out very soon, but specific information on it has not yet been made available.

Sludge Treatment Data from Detroit

In sludge filtration operations in the Detroit, Mich., sewage treatment plant, 63,931,000 gallons of sludge were conditioned with ferric chloride during the fiscal year 1951, and 41,101.000 gallons with ferric sulphate. Some sludge was conditioned with a mixture of the two chemicals and some with chlorinated copperas.

With ferric chloride, the dosage was 0.62 per cent on the basis of dry solids, with 9.4 per cent lime. The filter yield with this treatment was 4.4 lbs./sq.ft./hr. When using



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ferric sulphate, the dosage was 2.04 per cent, with 12.0 per cent of lime, and the yield was 3.5 lbs./sq.ft./hr.

Gas produced in the digesters amounted to 5.64 cu. ft. per pound of volatile added, a total of 87,533,-000 cu. ft.

Composting Garbage

(Continued from page 66)

ratio of 55:1. Furthermore, to learn about the minimum turning needs, the contents of one bin were turned daily, while those of the other were turned on every third day.

Both bins followed the usual cycle, attaining a temperature of fifty degrees centigrade within three days and a maximum of seventy degrees within a week; then decreasing in temperature at the end of the cycle. Progress during the initial part of the run was identical for both piles, but because of the excessive moisture in the bin turned only every third day, anaerobic conditions developed in the middle of the pile on the fifth day. This was remedied by daily turning thereafter. Actinomycetes were more abundant than in previous runs. Inspection vealed their predominance in the drier and more pervious parts of the pile.

Results indicate that a moisture content of 76 percent is the maximum allowable for maintaining aerobic conditions, while a lower percentage would be more desirable. Secondly, the maximum carbon ratio permitting composting is above 55:1. Thirdly, actinomycetes found in cellulose decomposition thrive in a relatively well aerated material. Fourthly, daily turning is not necessary excepting in materials with a percentage moisture in the upper seventies.

Berkeley Experiences

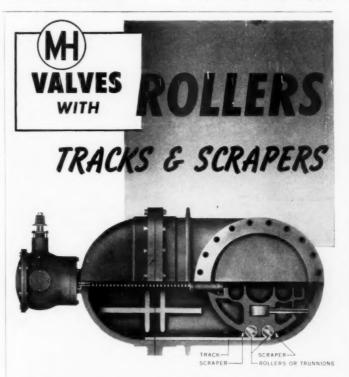
The information obtained in this study was at once put into use in an experiment on composting of city garbage at the Berkeley dump. This investigation was conducted jointly by the Refuse Collection Division of the city of Berkeley, under the direction of Owen Dyer, and the Sanitary Engineering Research Project of the University of California.

To insure good segregation of material and the maintenance of experimental conditions, only one load of garbage, weighing about 2½ tons, was processed daily. Selection of a

load from a different part of the city each day gave a good cross section of the types of garbage to be expected during normal operation. Garbage was fed onto a large conveyor belt where hand labor removed tin cans, bottles, rags, and miscellaneous uncompostable material. The amount of each type of material removed was weighed to obtain data on salvage, which can do much to lessen the expense of composting. Approximately 66 percent of the delivered garbage was found to be compostable.

The compostable material was delivered from the conveyor belt to an Enterprise EMV 3 grinder, trom which it was hauled and stacked in a pile. Each day's run was placed in a separate pile so that various moisture contents, turning schedules, and carbon-nitrogen ratios could be evaluated. Laboratory determinations of ash, moisture, carbon, nitrogen, phosphorus, and potassium were made each day.

Excellent composts were obtained within two to three weeks depending upon the percentage of paper



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originally present. The scope of the study was then expanded to include composts of garbage mixed with raw sewage sludge and with digested sludge. In both cases 25 percent sludge by weight was added with highly satisfactory results.

Better Concrete

(Continued from page 73)

cu. ft. so the voids in the sand must be the differences between 15.3734 and 7.6047 or 7.7687 cu. ft. Therefore, the voids in the sand are now $7.7687 \div 15.3734 = 50.53\%$. The voids in the surface dry sand were originally only 40.28% so that the increase in voids of 10.25% represents 10.25 ÷ 40.28 or an increase in voids of 25%. Again the increase indicates that the sand particles are not in contact, so the sand grains must be dispersed through the paste.

Computation Procedures

Voids in Cement-As the cement and water, or paste, must make up the volume not supplied by the stone and sand we find that this paste must occupy 7.7687 cu. ft. The cement being granular must have a gross volume of 7.7687 cu. ft. but the absolute volume was only 2.7046 cu. ft. so the voids in the cement must represent the difference between 7.7687 and 2.7046 or 5.0641 cu. ft. which is exactly the volume occupied by the 316 lbs. of water specified.

The voids in the cement must then be 5.0641 ÷ 7.7687 or 65.18%; however the original voids in the cement were only 49.5%. The increase of 15.68%, which represents 31% of the original voids, indicates that the cement has bulked to such a degree that the particles are not in contact but were floating around in water until hydration had progressed. It is apparent that this paste would be porous. The excess water, if it were retained as free water, could be the cause of much damage due to its expansion under low temperatures.

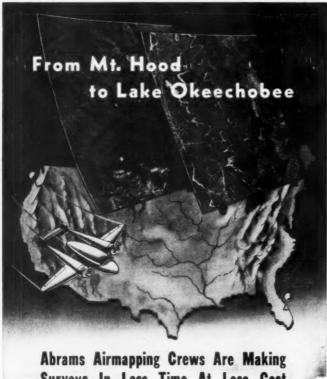
This method of analyzing concrete from the absolute volumes of each of the ingredients, and thus determining the increase or decrease in voids due to the water, has been checked against several hundred mixes during the past few years. Incidentally the mix which has been analyzed is, according to present practice, considered a good mix as the cement factor is about 6 bags per cu. yd. and the water cement ratio between 6.0 and 7.0 gals. per bag.

A Solution Proposed

As it is not fair to criticize, unless a better solution can be offered, let us now determine, using the same materials as in the first analysis, what the weights of stone, sand, cement and water should be for 27 cu. ft. of concrete, based on the voids in each of the materials in surface-dry condition. It is to be understood that the mixture of water and cement, which we call paste, is to be prepared in a separate, small mortar mixer.

Stone—Since the voids in the stone are 43.88% and in that condition the weight per cu. ft. is 95.6 lbs. we will require $27.0 \times 95.6 =$ 2,581 lbs.; also with 43.88% voids, the absolute volume is 27.0 x 0.5612 or 15.1524 cu. ft. The voids amount to 11.8476 cu. ft.

Sand-In order to fill the voids in 27.0 cu. ft. of stone, we will require 27.0 x .4388 or 11.8476 cu. ft. of surface-dry sand which weighs 98 lbs. per cu. ft. The weight of sand will be $98 \times 11.8476 = 1,161$ lbs. The absolute volume of this sand



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is 11.8476 (1.000 - .4028) = 7.0754cu. ft. The solid volume always equals 1.0 minus the percent of voids, which in the case of this sand are 40 28%

Cement-In order to fill the voids in 11.8476 cu. ft. of sand which has 40.28% voids, we will require 11 .-8476 x .4028 or 4.7722 cu. ft. of cement which at 99 lbs. per cu. ft. = 472.4 lbs. This cement has 49.5% voids, however, and the absolute volume = 4.7722 (1.000 - 0.495) =2.4100 cu. ft.

Water-In order to fill the voids in the 4.7722 cu. ft. of cement which contains 49.5% voids we will require 4.7722 x 0.495 or 2.3622 cu. ft. of water which, at 62.4 lbs. per cu. ft., weighs 147.4 lbs.

Our determined need then will be as follows: Stone 2,581 lbs.; sand 1,161 lbs.; cement 472.4 lbs.; and water 147.4 lbs. Tabulation of weights, absolute volumes and percentages of each in absolute volume as compared to the yield is shown in Table 2 on page 94.

Since 147.4 lbs. of water = 17.7 gals. and 472.4 lbs. of cement = 5.023 bags at 94 lbs. each, the water/cement ratio is 17.70 ÷ 5.023, or 3.52 gal. per bag; and the sand/cement ratio is 1161 ÷ 5.023, or 231.1 lbs. per bag, which is exactly what it should be for sand with 40.28% voids.

The total weight of materials is 4,361.8 lbs. for 27 cu. ft., a weight per cu. ft. of 161.5 lbs. This is an increase of nearly 11.0 lbs. per cu. ft. compared to the original mix.

Analysis of Voids.-Stone: Since we used 27.0 cu. ft. of stone, loose measure, which contains 15.1524 cu. ft. absol. vol., the voids in the stone must be (27.00 - 15.1524) ÷ 27, or 43.88%, which is exactly the voids in the original. Sand: Since 11.8476 cu. ft. of sand were used to fill the voids in the stone and the absolute volume of this sand is 7.0754 cu. ft., the voids in the sand are (11.8476 - 7.0754 ÷ 11.8476, or 40.28%, or exactly the same as the voids in the surface dry sand. Cement: Since 4.7722 cu. ft. of cement were used and this cement had an absolute volume of 2.4100 cu. ft., the voids in the cement are (4.7722 - 2.4100) ÷ 4.7722 or 49.5%, which is exactly the same as in the dry cement.

From the above calculations, it can be seen that there has been no increase in voids in the different ingredients due to their being combined into concrete. Therefore the particles of each are in contact: the strongest concrete will be assured; and strength will not necessarily

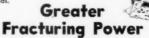


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TABLE 2-ABSOLUTE WEIGHTS, VOLUMES & PERCENTAGES

Stone 2,581 lbs. absol. vol. 15.1524 cu. ft. % of total volume 56.12 Sand 1,161 lbs. absol. vol. 7.0754 cu. ft. % of total volume 26.21 Cement 472.4 lbs. absol. vol. 2.4100 cu. ft. % of total volume 8.92 Water 147.4 lbs. absol. vol. 2.3622 cu. ft. % of total volume 8.75

Total weight is 4,361.8 lbs.; the yield is 27.0000 cu. ft.; percentage is 100.00

be based on the strength of the cement paste.

These results are possible only by using surface-dry sand and by adding cement paste to the sand and stone, this paste having been produced in a separate mixer. If these

ingredients should be placed all together in a mixer drum we would have bulking of sand, and in turn, air voids and honeycombing, with an increase in yield. A comparison of the two mixes is shown in Table 3 at the bottom of the page.

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The second mix shows an increase in stone of 612 lbs. per cu. yd. and a decrease in cement of 0.72 bag, which at current prices is about 70 cents. This saving will be offset by the cost of the increased stone and the drying of the sand. However, in one case you obtain 2,500-lb. to 3,000-lb. concrete, and in the other a concrete having a strength of 8,000 lbs. or more.

The only deviation from present practice is the fact that the sand used must be in surface-dry condition, and the paste of water and cement prepared separately and then added to the aggregates. There remains only one other difference. This concrete, to obtain its high strength, must be vibrated and/or compacted.

It is my opinion, after making a critical study of German concrete and of the Autobahnen during 1946 and 1947, that the main reason for building these pavements in two 4-inch layers of concrete was because even the heavy Dingler machines could not compact 8 inches at one time. However, the German pavements were in excellent condition even after 9 years use with no maintenance; and scaling was negligible.

The water/cement ratio used by the Germans was about 0.45 by weight or about 51/2 gals, per bag by U. S. standards, while I suggest about 0.32 by weight or about 31/2 gals. per bag. Prof. Freyssinet of France is approaching my figure on precast work, such as beams, pipes, and panels, obtaining strengths up to 20,000 psi. However, he obtains this low w/c ratio by a combination of heat, vibration and pressure.

The drying of course aggregates has not been stressed, as such aggregates do not bulk. They do, however, contain surface moisture which will act to dilute the paste and thus reduce concrete strength. So for best results all materials should be surface dry. The fact that voids in coarse aggregates and sand will be decreased due to vibration and/or tamping, thus using greater weights of these and a lesser weight of cement, has been ignored in the discussion.

This method of preparing concrete is covered by letters patent.

TABLE 3-COMPARISON OF MIXES

Bulletin Suggested Mix Mix 1.969 lbs 2.581 lbs.1,248 lbs. 1,161 lbs. Cement . . . 537.7 lbs. 472.5 lbs.

PUBLIC WORKS DIGESTS

THIS section digests and briefs the important articles appearing in the periodicals that reached this office prior to the 15th of the previous month. Appended are Bibliographies of all principal articles in these publications.

WATER WORKS 95
HIGHWAYS AND AIRPORTS 101
SEWERAGE AND REFUSE ... 107

THE WATER WORKS DIGEST

Precautions in Locating Gas Mains

Natural gas is now distributed into 40 states through more than 250,000 miles of pipe lines, under pressure of 750 to 1,000 lb. per sq. in. These pipe lines are of steel with welded joints, and leakage is improbable, but breaks or other escapes are possible. The Massachusetts Dept. of Public Health investigated the possibility of leakage of gas and contact of it with underground water, reservoirs, etc. objectionably affecting a water supply. The gas is 94.4% methane, 3 .-37% ethane and minute quantities of others; and is generally artificially odorized. With either odorized or unodorized gas escaping for 1 to 5 days through a volume of water 1/5 that of the gas, threshold odors up to 20-25 were obtained. Such actual conditions are highly improbable; but the Dept., to be perfectly safe, recommends that no gas transmission line be located within 400 ft. of any well used as a source of public water supply, or within 50 ft. of high water mark of any surface-water source of supply or tributary thereto, without special approval of the Department.

Ralph M. Soule—"The New Gas Transmission Lines in Massachusetts in Relation to Public Water Supplies;" Journal, New England Water Works Assn., June.

Phenolic Taste From Culm Piles

Salineville, Ohio has obtained its water supply from Riley Run since the fall of 1951. Chlorine is added, and ammonium sulfate, giving a

chloramine residual of 1.0 to 1.5 oppm without producing chlorinous taste in the tap water. Suddenly in March 1952 phenolic tastes became pronounced, and were traced to a refuse heap from a coal mine located up stream from the intake. This culm contained some coal, and this had ignited by spontaneous combustion, and phenols produced as a reaction product. These phenols were picked up by a small stream of mine discharge water which passes underneath the refuse heap and then flows into Riley Run. Tests of the water in this small stream showed it to contain 500 ppb of phenol, and the water in the 9.5 mg raw-water storage reservoir contained 5 ppb of phenol. Pumping from Riley Run into the reservoir was at once stopped. As a coincidence, the reservoir effluent also had a "fishy" taste. Activated carbon removed both tastes when applied at the rate of 60 to 80 ppm.

George Leishman—"Taste and Odor Problems at Salineville, Ohio;" Taste and Odor Control Journal, July.

An Unusual Large Intake

In connection with the construction of eleven new 250-ton furnaces at Pittsburgh, Pa., Jones & Laughlin Steel Corp. has constructed an intake in the Monongahela river for taking 120 mgd and providing for a possible 30 ft. rise in the river level. The intake structure is of concrete blocks, 146 x 45 ft. and extending from 16 ft. below normal pool level to 33 ft. above. The water first flows under a steel box float which skims off large floating

debris; then through heavy bar screens into 3 wet wells. In each well is a Link-Belt traveling screen 6 ft. wide with 3% in. square openings. Lime is added back of the screens to reduce the acidity of the river water. There are at present 3 pumps (with room for a 4th) drawing from two pump suction chambers, the middle one having a branch suction line in each chamber, so that two pumps can continue operating when one chamber is shut off for cleaning or pump repairs.

Charles W. Granacher — "New River Intake and Pumping Plant for Steel Mill;" Water Works Engineering, July.

Educational Program Averts Water Famine

San Diego, Calif., has proved that "information and persuasion can effectively bring about desirable public reaction to such broad and common problems as a water shortage." In the spring of 1951 the city and county of San Diego were faced with a water famine, with no possibility of increasing its supply for at least two years. Rationing the supply would require an almost impossible task of policing and arouse public opposition. With doubt of its success, voluntary conservation was tried, with a surprisingly gratifying result. A Citizens' Water Conservation Committee was appointed, and it retained a public relations man to coordinate the program. Newspapers, radio, TV and billboards were utilized to give the urgency of the situation the widest possible publicity, and to tell consumers how water could be saved in homes and gardens. Also speakers appeared beFor Sale

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One (1) Fairbanks-Morse, Synchronous motor, Type TZPB-FRVI, 1250 H.P., 720 R.P.M., 3-phase, 60-cycle, 13,200-volts, 43 amperes per terminal, unity power factor, exciter volts 115, temperature rise 40° C. continuous duty, field amperes 44 at unity power factor, Serial No. 323758.

Exciter, direct connected, type DGZO, Frame DX 100, Serial No. X58021, shunt wound, 7½ KW, 720 R.P.M., 12-volts D.C., 60-amperes.

The above motor complete with field control including rheostat, field discharge resistor, field contactor, and field application control.

One (1) bed plate for direct connection under pump and motor.

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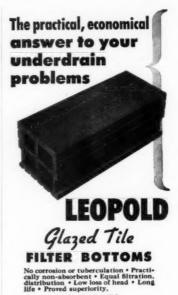
fore service and other clubs, and the schools gave the pupils facts and ideas to take home to their parents.

Before this program went into effect, water consumption had been averaging 28% above that of the corresponding month of the year before. In spite of a greatly increased population, the consumption in June, 1951, was only 10% above that of 1950; by August, and for the rest of the year, it was practically the same as the year before, and was less during the winter. Fortunately, long, heavy rains came in March, 1952 and the work of the committee was discontinued. The rains had produced enough reserve to last about two more years.

M. J. Shelton—"The Educational Program That Averted a Water Famine:" PUBLIC WORKS, August.

Legal Aspect of Fluoridation

According to the procedure for inaugurating the fluoridation of a water supply recommended by the A.W.W.A., this should be done only at the request of the local board of health and other city officials, the water utility acting as their agent and under the instruction of the dental and medical agencies. This instruction would include the size of the dose, which size these agencies are more competent to determine than the water utility. They also should be required to approve the equipment and method used. The utility then is responsible only for the execution of the program. It may be questioned whether the utility has a legal right to pay for equipment and chemicals used for fluoridation, its sole function being to supply safe and agreeable water. Therefore these expenses should be paid from the appropriate municipal funds as a health measure. There are not yet any statutory or case laws directly concerning fluoridation of public water supplies, but claims for damages to health, mottling of teeth, etc. would seem to lie against the municipal authorities directing the program, not against the utility, unless the latter can be shown to have given an implied warranty that the water would not produce the proved conditions or that it has been negligent in executing the program. It therefore behooves the utility to see to it that there be distinct legal evidence that it acts only as agent for and under



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the direction of the appropriate municipal and/or state authority.

Walter M. Franklin and John M. Murdoch, Jr.—"Fluoridation Experiences From a Manager's Viewpoint: A Panel Discussion:" Journal, American Water Works Assn., July.

Testing Radioactivity In Water

A task group appointed to study "Instrumentation and Methods for Testing Radioactive Contamination in Water," reported to the AWWA on May 5, 1952. It recommended four classifications of tests: 1-Geiger-Muller Survey; for rapid field surveys during civilian defense emergencies, to determine whether drinking water contaminated with radioactivity is within the permissible emergency levels. Instrument, a portable Geiger-Muller, thin sidewall tube, beta-gamma survey meter. 2-Landsverk analysis; for waterworks laboratory tests, sensitive below the 10-day and 30-day safe and acceptable risk levels. Instrument, Landsverk Model L-75 Analysis Unit. 3 - Proportional counters; for precise measurement of radioactivity ranging from extremely low activity at or just above the natural background to very high activity contamination. For use in only larger waterworks and public health department laboratories in critical areas. Instrument, proportional counters capable of counting activity from water samples evaporated on planchets. 4-Specific sources; to obtain data on extremely low activities in water arising from naturally occurring radioactive elements; and for identification of the kind and amount of these elements present: two difficult for most waterworks laboratories. Instruments, extremely sensitive low background proportional counters.

"Instrumentation and Methods for Testing Radioactive Contamination in Water;" Journal, American Water Works Ass'n., July.

Hazard of Poisoning by Carbon Monoxide in Recarbonation

In an Ohio water works plant the superintendent was seriously poisoned by carbon monoxide escaping from the recarbonation unit. As a result of this, the Ohio Dept. of Health investigated 16 plants using recarbonation, and found only 4 of these in which the recarbonation was carried on in the same building as the other treatment processes.

Where the recarbonation was not so located there seemed to be no hazard. They concluded that, for safety, the fuel burner should be so operated as to give a clear blue flame; the recarbonation chamber should be gas tight and be adequately vented to the outside. All recarbonation plants should be equipped with emergency respirators for protection of operators.

Richard D. Schafer—"The Carbon Monoxide Hazard in Water Recarbonation;" Water & Sewage Works, July.

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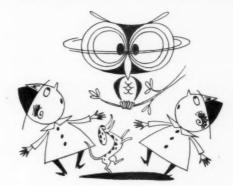
American City

High-Speed Water Treatment. By Ned Atkinson, Supt. of W. W., Vandalia, Ill. August, Pp. 85-87.

American Water Works Association Journal

A Program for Waterworks. By Charles II. Capen, Pres. A.W.W.A. July, Pp. 571-575. So-Called Electrical and Catalytic Treatment of Water for Boilers. By Rolf Eliassen, Prof. of San. Eng., and Herbert II. Chilig, Prof. of Metallurgy, M.I.T. July, Pp. 576-582. Instrumentation and Methods for Testing Radioactive Contamination in Water. Task Group Report, July, Pp. 383-594.

Head turns all the way around

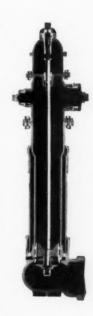


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Fluoridation Experiences from a Viewpoint. By W. Victor Weir. Pres. St. Louis Co. Water Co.; Walter M. Franklin, Gen. Supt. W. W., Charlotte, N. C.; James E. Kershke, Supt. of Filtration, Milwaukee, Wis; John E. Kleinhens, Indianapolis, Water Co.; G. Guy Morrow, Mer. Peoria, Ilt., W. W. Service Co.; George W. Pracy, Gen. Mar. San Francisco Water Dept.; Jerome C. Zufelt, Supt. Sheboygan, Wis. July, Pp. 595-516.

Sireft, Supt. Sheboygan, Wis. July, Pp. 578-516.
Simplified Procedures for Collecting, Examining and Recording Plankton in Water. By Widners and Recording Plankton in Water. By Widners Palamers, Biologist, Ohio-Tennessee Drainage Basins Office, and C. Mervin Palamer, Biologist, Pub. Health Service, Cincinnati, O. July, Pp. 617-624.
Photometric Methods in Water Analysis. By Eugene M. Diskant, Chemist, Los Angeles Water & Power Dept. July, Pp. 625-647.
Trained Operators—A Municipal Responsibility. By William T. Ingram, Assoc. Prof. of Pub. Health Eng. New York University. July, Pp. 648-654.

La Houille Blanche (France)

Simple Device for Reducing the Speed of Elasticity Waves in Pipes. By G. Reme-nieras. Asst. Chief of Hydraulic & Electric Studies and Researches. March, Pp. 172-196.

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Highlights of the Defense Program and Con-trolled Materials Plan as Affecting Water Works. By Walter L. Picton, Defense Pro-duction Administration. June, Pp. 129-134. Recent Developments in the Cambridge, Mass.

Water Supply. By Howard M. Turner, Cons. Engr. June, Pp. 142-166.
Limitations of Standard Bacteriologic Methods in Evaluating Sanitary Quality of Water. By F. Wellington Gilerea, Asst. Director. N. S. State Dept. Of Girera, Asst. Director. N. S. State Dept. os. Laborators und. Civil Defense. By Caryl C. Carson. Asst. Director. Conn. State Dept. of Health. June, Pp. 177-189.
The New Gas Transmission Lines in Massachusetts in Relation to Public Water Supplies. By Ralph M. Soule, Sr. San. Engr., Mass. Dept. of Public Health. June, Pp. 228-255.

Public Works

The Eductional Program That Averted a Wa-ter Famine. By M. J. Shelton, Gen'l. Mgr., La Mesa, Lemon Grove & Spring Valley Ir-rigation Dist. August, Pp. 60-61.

Water and Sewage Works

Water Rates (for Private Fire Protection).
By Pierce Bailey, W. W. Engr., Toledo,
Opino, July, P. 260 W. W. Engr., Toledo,
Opino of Small Water Works: Income and
Carlotte States of Small Water Works: Income and
Small Water Works: July, Pp. 270-271.
The Use and Abuse of Equipment in Small
Water Treatment Plants. By David E.
Barry, Asst. San, Engr., U.S.P.H.S. July,
Pp. 272-273.

Water Works Engineering

Insulated Cross-Connections Stop Pipe Elec-trolysis. By David Hendrickson, Sr. Elect. Engr., East Bay Mun. Utility Dist. July, Pp. 654, 682.

Modification of Percolation Test for Subsurface Disposal

Four suggested modifications of the standard percolation test for determining suitability of soils for subsurface disposal are suggested in "Studies on Household Sewage Disposal Systems, Part II" which was recently published by the Federal Security Agency. These modifications are:

(a) Use a 4-inch auger hole in which to make the test instead of the 12-inch square dug hole. It is easier to make, and no significant differences between rates with different sized holes were found.

(b) Obtain a reasonable number of replicate tests in any area in which a tile field is under consideration and use the average rate as the best approximation of soil absorption characteristics. A limited study indicates that this may be an important factor.

(c) Fill the test holes with water and allow them to soak overnight before making the percolation test. This is mort important in soils containing appreciable amounts of clay.

(d) In analyzing the percolation test data, the later period of the test is more representative of the true absorption rate of the soil.

Studies have indicated that the borderline between successful and unsuccessful operation of disposal fields is at sewage loading rates approximating 2 per cent of the unaffected soil percolation rates.

Research on Duck Waste Treatment

Pilot plants are now in process of construction in connection with the experimental program developed to work out methods of treating duck wastes from the extensive duck farms in Suffolk County on Long Island. The treatment plant will include a mechanical settling tank equipped with a screw conveyor for removal of sludge, an Imhoff tank, a three-compartment plain settling tank and three settling lagoons which may be operated in rotation. The program includes extensive studies on both the pilot plant operations and the fundamental characteristics of duck sludge.

The New York Water Pollution Control Board anticipates the duck growers will find, by next January, a satisfactory solution to the pollution problem their birds have caused. In this event, the Board will require that plans be filed before December 1953 and adequate facilities constructed by April 1954 to abate pollution of Moriches Bay by the duck farms.

Consideration is being given by the Joint Legislative Committee on Natural Resources to the introduction of legislation in the 1953 session providing for the establishment of districts wherein neighboring duck growers could construct joint treatment and disposal works.

"Most Highly Mechanized Sewage Works in the World"

Under this heading the English magazine Municipal Engineering describes briefly the Maple Lodge Works of the Colne Valley Sewerage Board, which was officially opened July 12, 1952. This plant serves eight communities, with others to be added later. It is said to be the largest plant in existence that incinerates its sludge. Digester gas supplies the power for pumping, generating electricity, etc. It purifies the effluent to a greater degree than comparable plants in the United States because of the greater density of population. On a site of 26 acres it treats sewage formerly treated by local disposal plants which occupied an aggregate area of 500 acres.

Device for Reducing Water Hammer

A French engineer, M. Remenieras, describes in the Belgian magazine "La Houille Blanche" a device for "reducing the velocity of elasticity waves in pipes," with application to certain water hammer effects. It consists of placing in the pipe an easily distorted, elastic element, such as a very flexible tube filled with compressed air. This increases in volume and therefore decreases the pipe capacity as the water pressure is reduced by increased speed; conversely, if a valve suddenly be closed, the increase in water pressure caused thereby reduces the volume of the "elastic element" and thereby increases the pipe capacity and decreases the velocity of the water flowing toward the closed valve.

Factors in Solving the Off-Street Parking Problem

METHODS of solving the off-street parking problem in small cities were discussed at the Fourth National Businessmen's Conference on Urban Problems, held in Portland, Ore. At this meeting, F. E. Cox of the Kawneer Co. outlined the methods of financing available to smaller cities for solving parking problems. Pertinent factors to be considered were listed as follows:

(A)-Shoppers will not walk beuond a certain distance. The smaller the city, the less distance they will walk. In a city under 50,000 people, it is doubtful if the majority of shoppers will walk more than 350 feet, or an ordinary city block, before the point of diminishing returns is reached; hence parking facilities should be provided within close enough proximity to the major shopping units to give efficiency.

(B)-Charge for parking must not be too high. It has been found that when the charge reaches more than an average of 10 cents per hour, the value of the off-street parking facilities gradually goes down. Regardless of the type of facility provided, the cost for parking should be kept within the 10 cent per hour average according to most authorities.

(C)-Length of time for shopping trips. The average woman shopper will take 2 hours or more for a shopping trip, usually about two times per month. It can thus be seen that off-street parking facilities at a reasonable rate must be provided, or she will go to the areas of the city where parking facilities are available with little or no restriction. Quite often these may be outside city limits.

(D)-Curb parking inadequate. With curb parking limited to an hour or less, it can be seen that this solution to the problem is entirely inadequate for the major shoppers of any district. Worrying about a parking meter showing a violation sign interferes with free movement of purchasing on the part of the

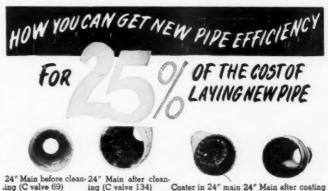
(E)-Multiple story off-street facilities vs. ground level. Where property values reach a figure of \$3 a square foot or more, it is generally considered that a multiple story parking facility is most economical. It is generally conceded that where the cost runs over \$900 per stall, the rate necessary defeats the intent of the enterprise.

(F)-Value of stalls can be measured in dollars and cents. There are many scientifically operated mercantile establishments today who measure the value of a parking stall off the street within 350 feet of an entrance in dollars of gross volume. These values run anywhere from \$12,000 per stall per year in sales volume to as high as \$50,000 per stall in gross sales volume. Types of business govern these val-1105

A merchant interested in computing a value of this kind can take his average unit sale and multiply it by the average number of passengers arriving per car, times the number of turnovers per stall per day, the result of which will give him the amount that can be sold to the people who park in such a stall each day. By multiplying such a result by the number of days he is open throughout the year, he can arrive at the value of the stall for those of his customers who arrive by motor vehicle. If he has a yearly budget of sales which he expects, it is a simple matter then to divide the dollar volume per year per stall into the yearly budget figure, and arrive at some reasonable estimate as to the number of parking stalls he should have under his

Reclaiming Old Road Material at 15 Cents a Yard

From a strip of abandoned road 2,000 ft. long, Nueces Co., Texas, has reclaimed 1,190 cu. yds. of caliche rock. The work was done by contractor H. B. Spradley of Agua Dulce, Tex. He used an Adams 512 motor grader to rip up the road and an International TD-9 crawler tractor with a Bucyrus-Erie dozer shovel to load the material into trucks. Loading was at the rate of 500 cu. yds. a day. Cost of the reclaimed stone was 15 cents a yard.



THE PITTSBURGH-ERIC PROCESS FOR RECONDITIONING - 3° TO 24" WATER MAINS IN PLACE

FAST: Up to 1000 feet of pipe can be cleaned and lined in ONE DAY

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Embankment Made Without Rolling

In western North Carolina this summer a 6.1 mile relocation project is under construction which includes 3,000,000 cu. yd. of unclassified excavation, a fill of 724,000 cu. vd.: a cut 183 ft. deep on the high side; and culverts under fills as high as 220 ft. Among the most notable features is that the fills are not made in layers and rolled but by end dumping; except that they are compacted immediately around the culverts. (Being financed entirely by state funds, it does not have to conform to Federal Aid standards). Permitting the contractor to choose his own method of filling resulted in low bids,-70 cents for unclassified material, in spite of high rock content. The plan is to carry traffic for a year or so on a temporary oiltreated gravel surface before permanent paving. This will allow the fills to consolidate and give time for weaknesses such as slides and slipouts to occur and be corrected.

Most of the culverts are corrugated, riveted pipe. Under the deepest fills, the pipes are placed in trenches excavated 2 ft. below the flow line and backfilled with selected material to give a uniform pipe bed. The vertical diameter is increased 3% by use of turnbuckles.

"Spectacular Mountain Road Job Being Graded Without Rolling;" Roads and Streets, July.

Flared Inlets For Culverts

The Bureau of Public Roads and the Oregon State Highway Dept. have been studying the possibility of reducing the size, and therefore the cost, of culverts by flaring the inlets. On the Pacific Highway in Oregon use of flared inlets for some large arch culverts made it possible to substitute 10-ft. arch barrels for culverts that otherwise would have required 12-ft. barrels. The use of flared inlets does not seem to be worth while unless the culvert grade is over 1%.

"Cost Savings Anticipated From New Culvert Design;" Engineering News-Record, July 17.

Providing Off-Street Parking

Lower Merion Township, a suburb of Philadelphia, Pa. with 50,-000 population, is meeting the demand for off-street parking in two ways. Its zoning ordinance now requires off-street parking spaces for all buildings hereafter erected; and spaces near existing buildings are being provided by cooperation with merchants. An area adequate for 110 cars was obtained by using the rear of two business properties and removing six houses obtained by condemnation proceedings. In one area half of a play ground was used for parking space for 90 cars. The costs of these have been recovered from receipts from parking meters along the highways. Meter rates range from 5 cts to 25 cts, the latter for 10-hr. parking by commuters.

The requirements of the zoning ordinance for future buildings of various types include 1½ spaces for each apartment of apartment houses

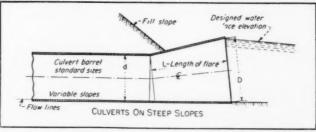
and hotels. One space for each 2 rooms in rooming houses and hotels; one for each 10 seats in theatres, schools and churches; and one for each unit of floor area in various types of buildings, the unit area varying with the type of building from 100 to 2,000 sq. ft.

Walter E. Rosengarten—"Solving the Off-Street Parking Problem;" PUBLIC WORKS, August.

Warping Stresses In Concrete Pavements

A Netherlands engineer, writing about joints in pavements, classifies these as expansion, contraction and warping. Warping joints, he says, are necessary to prevent cracking by the stresses due to a temperature or moisture differential between the top and the bottom of a concrete slab. Measurements made in Holland on a slab of 18 cm thickness during a hot summer day, gave a maximum positive temperature differential of about 12°C at 3 p.m. and a maximum negative temperature differential of about 4°C at 6 a.m.

Warping stresses are responsible for most of the cracks in our concrete roads. During a summer afternoon tensile stresses about a half or more of the tensile strength of the concrete can develop at the bottom of the slabs. The only way to



Courtesy Engineering News-Record

FLARED inlets may permit use of smaller culverts.



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reduce these warping stresses to rather a harmless value is the construction of very short slabs (10—15 ft.)

A. J. P. Van Der Burgh—"De Voegen in de Betonweg," Wegen, July.

Paper Snow Fences in Michigan

The Michigan State Highway Dept., after trying out a short section of paper snow fence in the winter of 1949-50, in 1951 installed five miles of it for a thorough test. The fence is made of strips 12 in. wide of two-ply paper, with a layer of fiber and asphalt between. These strips are stapled to wooden blocks fastened to small steel posts. This fence has withstood bad sleeting, heavy rain and high winds. The Department has not had time to correlate all the information on results from the performance of this fence last winter, but generally the answer is favorable. It takes up much less space in trucks and storage than does wooden fence and so reduces maintenance costs. An objection is the damage occasionally done to it by children or other thoughtless persons and by live stock.

"Paper Snow Fence Proves Economical in Michigan;" Roads and Streets, July.

Snow-Throwing Sidewalk Plows

Newton, Mass., in 1949 bought 2 hand snow-throwers for clearing sidewalks and 14 more the year after. They are operated by a gas engine and guided by one man. They plow approximately 28 in. wide in any depth of snow, economically and efficiently. They will deposit the snow on either side, and at a distance adjustable from 4 ft. to 50 ft. In Newton the snow is thrown onto private property, since the snow removed by the roadway plows occupied the narrow space between curb and sidewalk. Care has to be exercised to prevent the plow picking up snow faster than it can throw it and so packing into and stalling the machine.

Willard S. Pratt-"Snow Throw-

Mobile Unit for Highway Study



Shown above is an International truck with Aristocrat Service-Utility body which is playing a key part in the collection of data necessary for the construction of longerlasting concrete highways. truck, an L-130, is operated by the Portland Cement Association's research and development laboratories, Skokie, Ill., and serves as a mobile warehouse and prime mover for equipment used to test conditions of new and old concrete highways across the nation. Facts learned from these cross-country research expeditions are helping the Portland Cement Association in developing stronger, longer-lasting concrete. Special equipment hauled

by the truck includes the trailermounted 200-gallon water tank, and cutting machine with diamond drill used to cut eight-inch cores from concrete road surfaces. Water from the 200-gallon tank is used as a coolant and lubricant in the drilling process. Sample cores cut from roads are tested and studied at the Association's laboratories. Horizontal and vertical compartments of the truck body are used for storing small items of test equipment, while larger equipment is carried in the canvas-covered pickup body. The Aristocrat body is manufactured exclusively for International Harvester Company and factory-mounted by the Truck Engineering Company.

ers: Small One-Man Machines Prove Practical in Newton, Mass.;' American City, August.

Advantages of **Emulsified Asphalts**

Advantages claimed for emulsified asphalts are: No heat is required to unload from tank cars. When sprayed on aggregates, it penetrates deeply and deposits thin films on all particles. It is not necessary to dry aggregates before mixing. There are no fire and explosion hazards. It can be intimately combined with fine material, including sand and clay. It can be diluted with water in any proportion for use as a dust palliative.

Thomas L. Hodges-"Ideas in the Use of Emulsified Asphalt;" Roads and Streets, July.

Reclaiming Lubricating Oil

Replying to an inquiry whether it is practicable and economical to reclaim lubricating oils in highway garages, a number of county engineers and equipment superintendents agree almost unanimously in the negative. Detergents and other additives present in modern oils, which contribute to longer engine life and cut operating costs, are removed in the reclaiming process. They can be blended in with the reclaimed oil, but the cost in the end may be higher than the cost of new lubricant, and it is not at all certain that the result will be satisfactory.

"Are Oil Reclaimers Practical:" Better Roads, July.

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Better Roads

The Constructor

Contract Highway Maintenance Gaining Favor in Many States. July, Pp. 76, 79, 80.

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Engineering News-Record

Cost Savings Anticipated From New Culvert Design. July 12, P. 46.

Public Works

Sure-Fire Methods of Handling Parking Prol-lems. By Water E. Rasengarten, Lower Merion Township Engr. August, Pp. 57-58. How to Get More Space for Parkers. August, Pp. 58-59. How You Can Design and Build Your Own Prestressed Bridges. By Murray Coultos. August, Pp. 70-71, 76.

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Bituminous Surfacing on Roads and Airfields by Mechanical Finisher. By E. W. W. Kichards, July, Pp. 196-199. Investigation of the Compacting Effect on Soils of Track-Laying Tractors. By W. A. Lewis, Road Research Laboratory. July, Pp. 200-

Roads and Streets

Spectacular Mountain Road Job Being Graded Without Rolling. July, Pp. 41-49.

Snow Clearance a Bargain at \$5,000 an Inch. By Milton Rosen, Com'r of Pub. Wks., St. Paul, Minn. July, Pp. 58-60.

Papier Snow Fence Proves Economical in Michigan. July P. 61.

Toledo Chooses 6-In. Concrete for 350,000 Sq. Yd. of Streets. By Arnold V. Finch, City Mgr., Toledo, G. July, P. 64.

Lymona L. Hodges, Ann. Birumuls & Asphalt. By Thomas L. Hodges, Ann. Birumuls & Asphalt

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Carpet Failures. By A. S. Turner. County Surveyor. July 12, Pp. 435-436

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De Voegen in de Betonweg (Joints in Concrete Pavements). By A. J. P. Van Der Burgh. July, Pp. 163-167.

Enkele Opmerkinger in Verband Met Het Aanleggen Van Vegen in Slappe (Construction of Roads on Soft Subsoil), By H. Veth. July, Pp. 168-171.

Composting for Garbage Disposal

Several pilot projects to try out various methods of composting garbage to yield an odorless fertilizer have been established, according to the American Public Works Association. Michigan has a fifty-ton pilot plant at Vesterberg which transforms garbage into compost in 28 days. This compost is mixed with phosphate rock and sold as a balanced organic plant food. Two other pilot plants, using a somewhat different process, have been erected at Mt. Wolf, Pa., and Chicago's union stock yards. These composters turn a mixture of one part manure or sewage sludge to three parts garbage into fertilizer in from five to seven days.

Composting is the biological method of altering the composition of organic material to produce a stable humus-like end product. Raw material is fed into composters where it ferments through bacterial action. During decomposition the mass is periodically mixed by

mechanical means, making conditions more uniform throughout and also effecting more aeration.

The original raw material may have wide variation, including garbage; plant materials derived from parks, gardens and lawns; wastes from commercial and industrial establishments, such as fruit and vegetable markets; and even nightsoil or sewage-sludge solids. Best results are claimed to be achieved when the installations are located at a sewage disposal plant, since the sewage and garbage together produce a better quality compost.

An English Synonym for "Bugs"

According to the English magazine Contractors Record, when a new engineering scheme or mechanical installation fails to perform up to expectations, the engineer responsible often refers to the faults as "teething troubles" because this metaphor sounds better than "failure or partial failure, imperfection or error" in that it suggests difficulties that are to be normally expected during the preliminary phases of operation of all new





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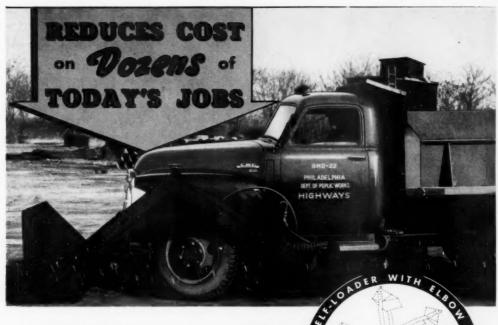
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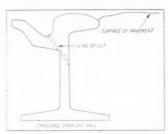


 OXWELD cutting machine mounted on two short track sections for continuous cutting.

Streetcar tracks offer a problem when repaving a street, and removal is likely to be costly. Monaca, Pa., cut the top off 10,037 ft. of track with machines mounting oxy-acetylene burners. The job was done by contract by a local welding and cutting shop. The rails were cut and the tops removed in 23 working days.

The tops of the tracks in Monaca were so high that paving over them was not feasible, due to high crown and low curbs. In a previous attempt to pave over the tracks, the rail grooves had been filled with concrete and concrete smoothed over the rail edges. This eliminated the skidding hazard but left ridges in the street.

Before the cutting was started, the concrete in the rail grooves was chipped out with a pneumatic hammer. Then the cut was begun using an Oxweld hand-cutting blowpipe. An Oxweld cutting machine continued the cut at an angle which allowed the removal of the entire top flange of the track. After the top section of the track was removed, the street was paved.



 CROSS-section view showing angle of cut to remove two top sections of the old rail.

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PUBLIC

DIGESTS

THE SEWERAGE AND REFUSE DIGEST

Oxygen Absorption Rating of Porous Air Diffusers

The flow of air through a dry porous plate used as an air diffuser is not a good criterion for evaluating its suitability for diffusing air into water, unless related to some other more direct and informative test. The actual amount of oxygen absorbed by the mixed liquor in an aeration tank is the determining factor in any comparison of diffuser plates. Purchase of diffuser plates on the basis of permeability results in wide variations in the air diffusing and clogging characteristics of products from different sources, and even from the same source due to changes in manufacturing technique. The oxygen absorption rating of porous plate air diffusers (which is described in the article) would assure the purchaser of obtaining a product of uniform performance, regardless of source of supply. The present permeability rating should be retained to assure uniformity.

Henry R. King-"Tests to Determine Oxygen Absorption Rating of Porous Plate Air Diffusers;" Sewage and Industrial Wastes, July.

Incineration of Refuse Replaces Dumping

New York City for some years dumped millions of cubic yards of refuse on outlying marshland areas. Available land suitable for this has been used to the point where there remains enough for only 15 or 20 years more of such use. Some of the refuse has been incinerated. Last year incinerators reduced 6,800,000 cu. yd. of refuse to 750,000 cu. yds. of residue. If all of the city's refuse were so reduced in volume, the land available for dumping could continue to be used for 125 to 180 yrs. Moreover, since the residue would be inoffensive, other land closer to residential districts could be used for fills, reducing the cost of hauling. Moreover, these fills could at once be used for building sites, which fills of raw refuse can not. Also the nuisances of odors, rats and flies would be eliminated. These advantages are offset by the costs of incineration-\$1.00 to \$2.50 per ton, not including fixed charges on construction costs. These, on the other hand, are offset by reduced hauling costs. The per capita refuse in New York averages 21/2 lb per day or 913 lb. per year. If the total cost of incineration, including capital costs, be \$2 to \$4 per ton, this gives \$0.90 to \$1.80 per capita per year.

The author describes the different types and designs of incinerators: in some detail in the case of two 1.000-ton incinerators being built in New York.

Henry Liebman-"Modern Incinerator Design Developed by New York City:" PUBLIC WORKS, Au-

Rapid Filtration of Sewage Effluents

Experiments were conducted in England by the Water Pollution Research Laboratory at Luton to determine the practicability of removing suspended solids from sewage effluents by passing them through rapid sand filters. Continuous operation for seven months of two rapid gravity filters, one containing 2 ft. of coarse graded sand (1.7 to 0.85 mm), the other containing 2 ft. of graded anthracite, showed that by filtration of humus tank effluent at rates up to 240 gph per sq. ft. the suspended solids could be reduced by an average of 72 to 98%, with reductions of BOD of 50 to 90%. There was no significant difference between the quality of effluents through sand and through anthracite. The filters were backwashed daily, after a preliminary scouring with air, at a rate of 800 gph per sq. ft. Chlorination to keep the medium free from accumulations of organic growth appeared to be unnecessary. There was little difference in quality of effluent between these filters and others containing 3 ft. 6 in. of similar sand when operated at rates below 275 gph per sq.

A. E. J. Pettet, W. F. Collett and J. J. Waddington-"Rapid Filtration of Sewage Effluent Through Sand and Anthracite:" Sewage and Industrial Wastes, July.

Effect of Detergents On Septic Tanks

Experiments were conducted at the University of Massachusetts to determine the effect, if any, of the presence of detergents in the sewage treated in septic tanks. Eight brands of detergents commonly available for household use and three sold for industrial use were used in the investigation. Observations or tests were made on turbidity, scum and sludge accumulation, settleable solids, total bacteria counts, numbers and types of coliform bacteria. ammonification, nitrate content, and hydrogen sulfide production. No evidence was found that household detergents, in concentrations likely to be present in sewage at any given time, would be detrimental to the proper functioning of septic tanks. Some industrial detergents might be slightly detrimental, but the risk is not serious.

James E. Fuller-"Detergents and Septic Tanks;" Sewage and Industrial Wastes, July.

Municipal Insect Control

Insect control by use of DDT. Lindane and other chemicals during recent years has been so easy and successful that old-fashioned principles of sanitation based on regularly scheduled inspection have been largely abandoned. But house flies

and mosquitoes are acquiring resistance to many known insecticides. and it is necessary to return to the old scientific methods of cleanliness. For mosquito control, drainage, dikes and tide gates, and other methods of elimination of breeding waters must be employed. For fly control also, breeding places must be eliminated in piggeries, stables, dairies, and manure and garbage disposal. These methods of larval control should continue to be supplemented by adult control by insecticides applied by personnel trained to know just when, how much and where to apply them, and the most effective equipment for applying them-Aerosol generators, mist blowers, airplanes, etc.

David G. Hall—"What You Should Know to Succeed at Municipal Insect Control;" PUBLIC WORKS, August

Spray Irrigation Of Cannery Wastes

The Lakeside Parking Co. plant at Plainville, Minn., canners of peas and sweet corn, in 1941 joined with the village in constructing a treatment plant to provide treatment of the domestic sewage and the

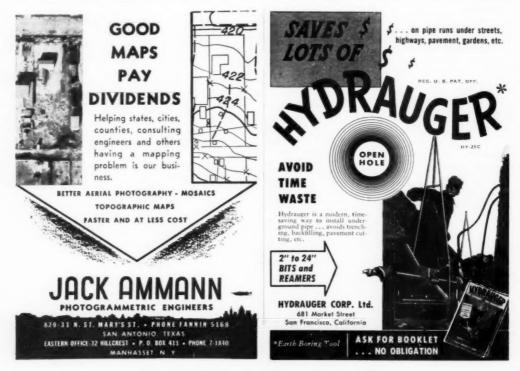
seasonal flow from the cannery, the effluent from which discharges into a waterway which is otherwise dry most of the time. After a few years it was apparent that the plant could not adequately handle the heavy load of waste from the cannery, and the company constructed on adjacent land a lagoon with a capacity of 30 mg, an entire season's flow. In spite of a generous use of sodium nitrate, the odors from the lagoon resulted in 1950 in an injunction against its further use. Enlarging the treatment plant to a size sufficient for treating all the waste would cost more than \$250,-000, and it was decided to try spray irrigation for the 23.8 mg of liquid waste produced during the canning season. The waste passes through a 20-mesh rotary screen to a wet well, from which it is pumped through 6,200 ft. of 7 in. main line and four 980-ft. sprinkler lines for spraying onto 110 acres of crop land. Should it be necessary, cooling water can be pumped into the lagoon to reduce peak flows in the sprinkler system, to be pumped back into the sprinkler system afterward. There are four sprinkler lines, each provided with 25 sprink-

lers which cover a width of 60 ft. The general practice is to move the sprinkler lines twice a day, two being in use while the other two are being moved. This is facilitated by using light-weight aluminum pipes. The farm is divided into six 18-acre fields, on which are grown sweet corn, peas and alfalfa in rotation, the corn and peas for one year each and the alfalfa 4 years. The cost of equipment was \$21,050. The annual cost in 1951, including the depreciation, \$1100 rental of land and interest, was \$6,625; income from crops, \$4,400.

Leonard E. Nelson—"Cannery Wastes Disposal by Spray Irrigation;" Wastes Engineering, August.

Treatment of Asbestos Paper Wastes

Pilot plant studies were made by a company making asbestos paper and asbestos mill board at Norristown, Pa., to find the best procedure for reducing stream pollution, recovery of fiber and production of sludge usable in the mill, clarification of water for reuse in process operation, and reduction of heat losses. The studies included use of



vacuum filtration equipment, pressure filtration equipment, sedimentation equipment with and without chemical treatment, and high-rate sedimentation. Rotary drum filtration was found to be unsatisfactory, and cost of equipment, space limitations and labor for operations were considered objectionably high. Pressure filtration using diatomaceous earth gave a good effluent, but there was encroachment of fibers into the screens, backwashing difficulties and excessive operation costs. Sedimentation and flocculation did not give a satisfactory effluent. Test of an Infilco Cyclator led to the adoption of a 1200 gpm unit of this, which has been operating for more than 4 months.

R. W. Simpson, E. T. Duke and K. Thompson—"Asbestos Paper Wastes Treatment:" Water & Sewage Works, July.

Sludge Gas as Motor Vehicle Fuel

In Germany a number of sewage treatment plants purify the sludge gas from the digestion tanks and sell it as a substitute for gasoline in running motor vehicles. In the Ruhr District today 7.800 vehicles use this gas. The gas is sold compressed in steel containers, which are so heavy that the use is confined to trucks. These, however, are adopting Diesel engines and only the older ones use sludge gas, and this use will probably continue for not more than ten years. At one plant which serves 290,000 persons, the sludge gas consists of 65% methane and 35% carbon dioxide. The volume averages 211,900 cu. ft. per day. It is compressed by 5-stage compressors to 350 atmospheres. Between the second and third stages, at a pressure of 20 atmospheres, the gas is washed with water spray, removing 95% of the carbon dioxide and some hydrogen sulfide. The operating cost for producing 45,500,000 cu. ft. of salable methane per year is \$23,600; at present sale price, this brings \$75,000. The construction cost of the plant was \$129,800.

Karl Imhoff-"Sludge Gas as Fuel for Motor Vehicles:" Water & Sewage Works, July.

Elutriation as a Substitute for Secondary Digestion

At the Jamaica treatment plant of New York City, 40 mgd of sewage per day is treated by the highrate activated sludge process. The excess sludge is subjected to twostage digestion, and the digested sludge is pumped through a long pipeline to a storage tank, from which it is barged to sea. In 1950 it became necessary to increase the capacity for primary digestion by changing some secondary tanks to primary digestion. The major contribution of secondary digestion is the concentration of sludge solids, reducing the volume of sludge to be barged to sea. As a substitution for the secondary tanks changed to primaries, elutriation plus storage was tried. High-level digester liquor. averaging 2 to 3% solids, was concentrated by single-stage elutriation to 3.9 to 7.4% solids, without excessive loss of solids in the elutriate, being as effective in concentrating digested sludge solids as a secondary digester with 12 times the volume. By quiescent storage of elutriated sludge with 5% total solids, a sludge with more than 10% total solids was obtained after 80day storage. No adverse effect on the modified aeration process was noted as a result of sending elutriate back to the wet well.

Wilbur N. Torpey and Martin Lang-"Elutriation as a Substitute



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AMERICA'S LARGEST MANUFACTURER OF PIPE CLEANING TOOLS AND EQUIPMENT for Secondary Digestion:" Sewnge and Industrial Wastes, July.

Results of Remodeling **Baltimore's Trickling Filters**

For many years Baltimore, Md. has been operating 30 acres of trickling filters-the largest filter plant in the United States. In 1938-39 experiments with 8-arm rotary distributors were made, at rates ranging from 6.5 to 30 mgad, as compared with the 313 mgad previously employed. Up to 14 mgad, BOD reductions were obtained of 79 to 90% in summer and 71 to 73° in winter, and results indicated that the capacity of the filters could be increased considerably without detrimentally affecting their performance or the quality of the effluent. Therefore the filters were remodeled, using 50 rotary distributors, each 157 ft. 6 in. in diameter. One of these was built as a test filter with provision for taking samples at four different depths. In Sept.-Oct. 1951 tests were conducted, which showed that the results being obtained were even better than those in the 1938-39 experiment. Removals in excess of 80°, were obtained with loadings ranging from 2.68 to 13.53 mgad. With a loading of 500 lb. per acrefoot per day 90% average removal was obtained, and 69% with a load of 8,000 lb. About 80% of the removal occurred in the top 2 ft. of

C. E. Keefer and Joseph Meisel-"Remodeled Trickling Filters Exceed Expectations at Baltimore:" Water & Sewage Works, July.

Intermittent Sand Filters

Installation of intermittent sand filters is infrequent, but they still have their advantages for use in some instances, as at small, isolated institutions where a highly oxidized, stable effluent free from suspended solids and with a low bacterial count is necessary, or at large institutions lacking a convenient water body for disposal of treated effluents but possessing large natural sandy areas. They are also adaptable to these installations because of their non-mechanical features, the use of non-skilled labor in their maintenance and possibility of using patients for this purpose. They are in use at many New York State institutions, large and small. In designing these, the engineers of the State Dept. of Public Works have developed certain features as standard. Not less than 2 units: 3 are preferred. Depth of sand, 2.5 to 3.0 ft. above underdrains: effective size. 0.20 to 0.50 mm, preferably 0.25-0.35. Settled sewage, 40,000 to 100,000 gpad. Maximum lateral travel, 20 to 30 ft. Underdrains, not less than 4 in., spaced not more than 25 ft. apart. Distribution onto the beds is made upward through vertical pipes with bell-mouth outlets onto paved aprons spaced not more than 40 ft. apart; at the rate of 1 cfs per 5,000 sq. ft. of bed. Perforated pipe is recommended for underdrains.

Joseph C. Federick-"Use of Intermittent Sand Filters at Institutions:" Wastes Engineering, July.

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Method of Estimating Sewage Plant Costs. By Joseph C. Federick, Asst. Dist. Engr., X. Y. State Dept. of Pub. Wks. July, Pp. 292-294.

Western City

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Roads For Tracked Vehicles

Road Research Road Note No. 13, published by the Dep't. of Scientific and Industrial Research. London, S.W. 1. gives recommendations for bituminous surfacings for roads carrying tracked vehicles. Wartime experience showed that special surfacing mixtures were needed to withstand the wear of heavy tanks and other tracked vehicles. The recommendations given here are based on a recent survey of mixtures which have given satisfactory service for at least five years. Some of the mixtures were devised by the Road Research Laboratory, others were suggested by member firms of the Asphalt Roads Association and the British Road Tar Association.

Three types of mixtures are dealt with. Compositions used where tracked vehicles turn sharply by locking one track receive very heavy stresses demanding specially

resistant surfaces. Where most of the traffic is tracked but vehicles do not turn a material capable of withstanding the hammering and polishing action of the tracks is needed and the composition must be such that it will resist the tendency of the vehicle to sink in during warm weather. On ordinary highways carrying a proportion of tracked vehicles the material must be resistant to wear but must remain reasonably skid resistant for ordinary wheeled traffic.

Suitable compositions for meeting the varied demands on tank training grounds, on corners and intersections of roads, on roads carrying a high percentage of tracked traffic and on ordinary roads are described. Illustrations show the effects on various types of surface of heavy tank traffic. This booklet sells for 30 cents.

Brush Control

(Continued from page 69)

and all, by either hand or cable. This was slow and exceedingly expensive. Trees and brush grow so fast in Louisiana it was literally true that the growth along these many channels was faster than a sizable "pulling crew" could keep up with.

Some of the disappointing results of these mechanical and manual attemps at brush control were evident when Frank Evans took me on my first inspection tour of these canals. What could be expected from chemical brush killers? The need for an answer was urgent!

Chemicals Solve the Problem

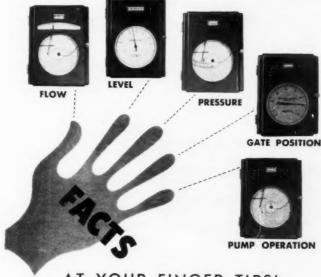
To get that answer, we tapped the experiences of industrial firms and public utility companies that have been battling brush with chemicals since the early days of 2.4-D. For a new era in the chemical control of brush and weeds was ushered in during the '40's with the introduction of the new organic herbicides. Up to that point, weed killing materials had largely been of a soil sterilant nature-chemicals that blistered the growth and rendered the soil incapable of producing crops or a grass cover for a long period of time. Most of these were poisonous; many of them tended to create fire hazards.

With an annual rainfall of 60 inches, it was vital that some chemical be used which would allow grass and weeds to come in thick, preventing erosion of the

canal banks. Most important, of course, was the selection of a chemical which would be "translocated" within the plant—that is. absorbed by the leaf structure and moved through plant tissues down into the roots. Top-kill alone is no basis on which to judge effectiveness of brush killers. As long as roots are alive, resprouting will occur.

This narrowed the choice of materials down to three chemicals— 2,4-D; its chemical cousin 2,4,5-T; or ammonium sulfamate, better known as "Ammate" weed killer. Now 2,4-D was no newcomer to Pointe Coupee. A. B. Curet, the parish agricultural extension agent, had observed its effects as a weed killer in fields of rice and in small grain crops. Some had even been used on the courthouse lawn at New Roads. It was accepted as an outstanding chemical to select and kill broad-leaved weeds without producing serious injury to grasses or other narrow-leaved crops.

But this very selectivity ruled 2,4-D out as a material along the canals. There the mixture of trees



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must meter and control many variables. Chronoflo Telemeters pay "extra dividends", too, by releasing personnel for other duties.

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"The Use of Copper Sutscopic Organisms" by Dr. Frank E. Hale (former Director of Laboratories, Dept. of Water Supply, City of New York) is an authoritative work concerning the control of micro-organisms and elimination of tastes and odors. Describes in de-

tail methods of controlling various forms of micro scopic life commonly encou ntered in water supply systems, Contains descriptive material, plus 48 photo-micrograph studies of organisms d

ROOT AND FUNGUS CONTROL



Copper Sulphate for Root and Fungus Control in Sanitary Sewers and Storm Drains," by John W. Hood, contains information published for the first time. This material includes actual methods for control and operating

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and brush of several different species required a material which would kill all the growth to which it was applied.

The second material, 2,4,5-T, is more potent than 2,4-D and effective over a wider range of plants. Visits were made to inspect canal banks maintained by a gas pipe line company where heavy stands of willows and cottonwoods were seemingly quite dead following a spraying with a 50-50 mixture of 2.4-D and 2,4,5-T. Here, it appeared, was something worth trying.

Again, Ammate was no newcomer to this part of the country. It was the Southern Forest Experiment station of the U.S. Forest Service, with headquarters in New Orleans, which had first worked with this chemical to kill unwanted hardwoods in Louisiana's valuable pine stands. This had been done by introducing a concentrated paste of the chemical, or dry Ammate crystals, into "frills" or "cups" cut with an axe in the tree trunk.

Now, however, we viewed other types of application. Along power and telephone line right-of-ways we saw sections which had been sprayed with an Ammate solution. Here were the same mixed species of brush and trees which lined the Pointe Coupee canals. Two years after application, the ground was carpeted with grasses and annual weeds. You had to hunt for an occasional brush sprout. For Ammate weed killer is correctly termed a "non-selective" herbicide. It makes no distinction among species of woody plants.

As a result of these excursions, two test plots were sprayed along one of the most overgrown sections of a Pointe Coupee canal. On one of these sections, a mixture of 2.4-D and 2.4,5-T was sprayed. The other section was treated with the proper concentrations of an Ammate spray.

It was late summer when the sprays were put on. The results were checked the following spring. Much of the brush seemed to have been killed in both plots. But with some brush species there was considerable resprouting in the 2,4-D and 2.4.5-T plot, while where Ammate had been applied only a few feeble attempts at sprouting were in evidence

Frank Evans' appraisal of the results were: Plot No. 1: the 2,4-D and 2,4,5-T combination, would require retreatment of portions of the area the year following appli-

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cation, due to selectivity of these chemicals. Plot No. 2: the Ammate weed killer, produced virtually 100 per cent top kill and better than 80 per cent root kill; retreatment would not be necessary for several vears.

Another characteristic of 2,4-D and 2,4,5-T caused some apprehension. Both these chemicals are known as "volatile" materials in their most common formulations. They tend to vaporize, particularly in warm weather. A very minute amount of these materials, either as vapors or drift from the spray nozzle, can cause serious damage to sensitive crops such as cotton and tomatoes, located some distance from the sprayed area. Since farmland on which such crops are grown are adjacent to much of the Pointe Coupee canal system, this chance of crop injury seemed a large liability to assume, even though the cost of the chemical would have been less than for Ammate.

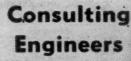
Having decided that Ammate weed killer should be the spray material used, next consideration was the selection of equipment and a method of getting the sprayer in position to cover the troublesome growth. Best coverage, it was determined, could be attained from the top of the canal bank, spraying down onto the brush and trees.

This meant that a bulldozer would have to cut a road along the crest of the bank. A 300-gallon orchard sprayer was purchased and towed behind the dozer. This developed about 200 pounds pressure, delivering 15 gallons per minute from two spray hoses. One of these hoses was 20 feet long, the other 40 feet long, enabling the nozzle operators to work some distance from the spray rig. The coverage was divided -one taking the top half of the trees, the other the bottom half.

The spraying started using Ammate weed killer at the rate of three-quarters of a pound per gallon of water. In some places, growth along the banks was from 25 to 30 feet, "both high and wide," to quote Mr. Evans. In other sections only low brush was found. The first year spraying cost averaged about \$200 per mile. Today that cost has been cut considerably since it was found that a half-pound of Ammate per gallon seems to be just as effective.

The secret of getting results with this lower rate of chemical, Mr. Evans believes, is in thorough coverage of all the leaf surface. Spray-

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ing is carried on from early May to mid-September, when all growth is in full leaf. About 300 gallons of spray per acre is used and Evans warns: "Just be sure you get it dripping wet!"

Those who wish to use Ammate spray on brush might profit from another technique used in the Pointe Coupee work. Four ounces of a chemical known as "spreadersticker" are added for every 100 gallons of spray. This is a material used first by orchardists to achieve an even coverage with their insecticide sprays. It lowers the surface tension of spray droplets, allowing the material to flow out over leaf surfaces, and exposing a greater area for penetration of the chemical into the plant structure.

Before spraying started this spring, 110 of the 400 miles of canals in Pointe Coupee Parish had been sprayed. Approximately a million dollars in parish funds are invested in the drainage project. Chemical brush control has now been accepted as a primary step in protecting that investment.

. . . **Better Operation**

(Continued from page 60)

Sludge pumps should be located as near as possible to the elevation of the bottom of the digester (or below it). Piston pumps will pull a vacuum, but you cannot clean out a digester pulling a vacuum. It is costly to have to "bucket" out the bottom four feet or so of sludge. Digesters need cleaning sooner or later. A manhole in the side, a pipe through the wall or some other device should be provided to remove the sludge that the pump will not handle

Sludge beds are most efficiently cleaned by trucks filled by tractor front-end loaders. Many sludge beds are so cut up by concrete walls and steep-sided dikes that about the only way to clean them is by hand shovels and wheelbarrows. Some cities have abandoned their original sludge beds because they could not work equipment in them and they were too costly to clean by hand.

Design should be based on the idea that the plant operators will be mediocre. This is not always the case, but in small plants it is likely to be. Designing engineers should from time to time revisit the plants they design, note where "bugs" have been found and determine how these can be eradicated in future designs.

Water Filtration

(Continued from page 64)

rather than any characteristic or limitation of the underdrain system.

While the above premise should be recognized, it is a fact that porous plate underdrains will permit, without any ill effects, greater variations, than any other filter bottom design in rates of filtration and backwash (even to the extent of accidental abuse). This is due, of course, to the simple elimination of all graded gravel. Excessive rates of filtration cannot result in loss of media through the underdrain system, and excessive backwash or "bumping" cannot result in any upset of the filter bed.

Beyond the foregoing protective feature, porous plate filter bottoms provide a further advantage over any system employing graded gravel in the event of any accident requiring access to the underdrain construction. Filter media can be shoveled to one side or otherwise removed without regard to gradation; repairs made; and the media put back, all in a matter of a few hours, possibly minutes. In contrast. if the media is supported by graded gravel, a long, expensive and tedious process of removal, regrading, and replacing is involved.

From the beginning, a substantial long-range reduction in operation and maintenance costs was claimed for porous plate filters. The cost of regrading gravel once every ten years, for example, would substantiate this statement. There are other small but cumulative savings when porous plate underdrains are used. Pressure losses both during filtration and backwash are reduced slightly, and under most conditions these effect power savings. There is no loss of filter media that must be replaced.

More recently, with skyrocketing construction costs, the initial cost of porous plate-equipped filters has proved to be lower than types utilizing graded gravel. The elimination of the cost of graded gravel in place is the big factor. Other savings are decreased concrete volume due to shallower construction, slightly reduced piping, and general elimination of metal facilities which have become costly.

At the present writing it is estimated that porous plate filter bottoms in place will range in cost from \$5.00 to \$7.00 per square foot, depending on size and location.

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Chromate anti-rust paints, designed for the most severe conditions, are available in black, red, gray, green and aluminum. No surface preparation is needed—the paint can be applied over existing rust. Only one coat is required, and this anti-rust paint can be painted over without bleeding through the cover coat. 4-page treatise from The Chem Industrial Co., Brooklyn, Ohio.

Use coupon on page 28; circle No. 9-14

Light-Weight Centrifugal Portable Fire Pump

A new light-weight gasoline-powered portable centrifugal pump is available for firefighting duty in isolated or inadequately protected areas. Weight is 57 pounds: capacity is 15,000 gals. per hour. It delivers water at pressures up to 100 psi. as stream, spray, fog or foam. The impeller is non-clogging; lubrication is from the fuel mixture. More data from McCulloch Motors Corp.. Los Angeles, Calif.

Use coupon on page 28; circle No. 9-15



McCulloch fire pump.

STOP WATER SEEPAGE SEWAGE CORROSION

WITH FORMULA No. 640

a clear liquid penetrating (1'+)
sealer for concrete and masonry
preventing water absorption and
reducing the action of acids. Holds
12' hydrostatic head. Use our Hayproc Rubberized Enamel for color on
walls and floors—not affected by concentrated acids, alcohol, oil, or traffic
abrasion.

30 OTHER PRODUCTS
Write for technical data.

Haynes Products Co., Omaha 3, Nebr.

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DEPENDABLE JOINTING COMPOUND

Seals Bell and Spigot Water Mains
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Over 35 Years Of Dependable Performance

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MAIN SALES OFFICE 50 CHURCH ST., N.Y.C.

General offices and works W. Medford Sta., Boston, Mass.

Grid Roller Helps Salvage Bituminous Surfaces

Designed to haul behind a motor grader or tractor, this grid roller is claimed to solve the problem of salvaging bituminous surfaces, no matter what their age. It disintegrates the old mat material, compacts the base, and rolls the new surface.



Grid roller for better salvaging of bituminous surfaces.

Counterweights are available to produce a gross weight of about 30,000 pounds. Grids are solidly welded to wheel side plates and the hardness of the grids has been increased to about 340 Brinell to give wear resistance and toughness. Data and complete catalog from Hyster Co., 2502 NE Clackamas St., Portland 8, Oregon.

Use coupon on page 28; circle No. 9 - 16

Side-Dump Truck Bodies for Heavy-Duty Work

For jobs where side-dumping is desirable, the new "Roll-Over" side-dump type of body is available from Galion Allsteel. These will dump to either right or left side, as desired. The bodies can be mounted on standard trailers of most any



These truck bodies will dump to either side, as desired.

make. Operation is entirely mechanical. To effect dump operation, the spring lock chain on the opposite side of the body to which the load is to discharge is released. Righting of the body is accomplished by a slight snaking movement of the truck. Various sizes are available. Data from Galion Allsteel Body Co.. Galion, O.

Use coupon on page 28; circle No. 9 - 17

Bleachery Waste Disposal Uses pH Control

Acid and alkaline wastes at a New England bleachery are collected in equalization tanks and then mixed in an underground basin. The pH of the mixed waste is controlled by a Foxboro recording controller. A small circulating pump supplies a continuous sample to a flow-type electrode. The controller operates a rubber-lined Saunders valve in the acid line to maintain the desired reaction. The installation maintains automatically the mixture of wastes within the desired tolerance, despite variations in acid and alkaline waste concentration and rates of flow. Final treatment of the waste is by trickling filters.

Wanted: A Man of Special Accomplishments

"We are looking for a rather special person who can function as business manager of our department (a large water department). We want both accounting and office management experience and a personality forceful enough to supervise personnel and meet the public. The job is an outcome of three basic needs: Improvement of public relations: office efficiency; and coordination of the accounting and bi.ling and collection sections. The salary range is \$475 to \$600, with a probable start near the middle of this range."

The location is in the southwest. Requests for further information should be addressed to HJG, care of W. A. Hardenbergh, at Public Works Magazine. Letters will be forwarded from this office without acknowledgment.

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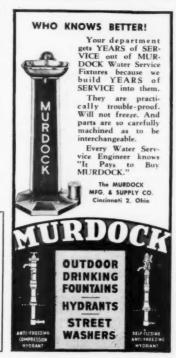
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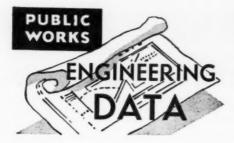
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INDEX OF ADVERTISEMENTS

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•	
Abrams Aerial Survey Corp. Aco Pipe Cleaning Contractors, Inc. Albirdin & Friel, Inc. Allia-Cholmers Alverd, Burdin & Avesan Amenda Survey & Surve	92 48 113 21 113 108 8 9
Baker, Jr., Michael Bannister Engineering Ce. Banbar-Greene Ce. Barbar & Wheeler Black & Weatch Bayer Assoc. Clinton L Boyer Assoc. Clinton L Boyer Assoc. Clinton L Bower Albertson Assoc. Bowersten Shale Ce. Brown & Blauvelt Brown Company Brown Company Brown Engineering Co. Buck, Seifert & Jest Burds & Nile Burges & Nile Burges & Nile Burges & Miche	61 113 113 & 9 113 27 113 113 111 113
Caird, James M. Camp, Dresser & McKee Capitel Enjoineering Corp. Carter Co., Ralph %. Caterpillar Tractor Co. Champion Corp. Chicage Bridge & Iron Co. Chicage Bridge & Iron Co. Chicage Bridge & Iron Co. Clicage Bridge & Iron Co. Clicage Bridge & Iron Co. Clicage Regione & Pump Mfg. Co. Clicage Regione & Pump Mfg. Co. Clipper Mfg. Co. Clipper Mfg. Co. Consocer, Townsend & Assoc. Continental Steel Corp. Continental Steel Corp. Converse Cooper-Resemer Corp. Conson, Oscar	113 113 114 30 113 80 114 77 3 119 22 37 114 44 114 102 29 51
Durley & Ce., W. 5. Durling Velive & Mrlg. Ce. Deleuw. Center & Co. Dempster Brothers, Inc. Dickey Clay Mrlg. Co., W. 5. Dolge Co., C. 8. Dow. A. W. Inc. (See Roots-Conservitle Blower Corp.) (See Roots-Conservitle Blower Corp.)	112 43 114 31 38 & 9 81 114
Eagle Crusher Co. Eagle Signal Corp. Eastern Gunite Co.	103 33 102
Fairbanks-Morse & Ce. Fisher Research Lab. Inc. Flexible Pipe Cleaning Co. Flexible Sewer-Rod Equipment Co. Frink Sno-Plaws. Inc.	15 82 94 109 32
Galion Iron Works & Mfg. Co. Gannett, Fleming Corddry & Carpenter, Inc. Ger Wood Industries 40 General American Transportation Corp. General Chemical Division Gieseke, George Gilbert Associates, Inc. Globe Phene Mfg. Corp. Government Employees Insurance Companies Gorman-Rupp Co. Grace Sign & Mfg. Co. Grace Sign & Mfg. Co. Greeley & Hanson Greeley & Hanson Green Co. Howard R.	8 41 49 35 114 114 96
Harte Co. John J. Hasie & Green Engrg. Co. Havie & Green Engrg. Co. Havens & Emerson Hays Products Co. Havens Products Co. Havens Products Co.	114 114 88 114 86

Hill & Hill Hoffco, Inc. Hoffco, Inc. Holmes Ce., Ernest Homestbed Valve Mfg, Ce. Hooper, William I. Hydraulic Development Corp. Hydraulic Development Corp. Hoffco, Inc.	114 88 105 14 115 118 108
Infilice, Inc Industrial Materials Co	84 4
Jaeger Machine Co. Jeffrey Mfg. Co. Jones, Henry & Schoonmaker	89 12 115
Kennedy, Clyde C., Co	115 115
Lake Shere Markers Layne & Bowler, Inc. Leopold Co., Inc., F. B. Lewis, Harold M. Link-Belt Co. Littleford Bros., Inc. Lock Joint Pipe Co. Lazier & Co., Wm. S.	119 16 96 115 47 48 123 115
Meterele, Inc. M & H. Valve & Fittings Ce. M. Wane Cast Iran Pipe Co. Metcalf & Eddy Murdock Mfg. & Supply Co.	79 91 78 115 119
Notional Clay Pipe Mfrs., Inc. National Fireproefing Corp. 8 Netional Surety Corp. Natural Rubber Bureau Neonah Foundry Co.	52 4 9 24 6 120
Oliver Corp	25
Pacific Flush Tank Co. Palmer Filter Equipment Co. Palmer & Baker. Inc. Permutir Co. Presider & Scholz Phelips Dodge Refining Corp. Phelips Inc. Boyd E. Primie Engineers. Makelim Pittometer Company Pittburgh-Des Moines Steel Co. Pittburgh-Pips Cleaner Co. Pomena Terra-Corla Co. 8 Proportioners. Inc. Public Works Magazine 78	82 104 115 10 115 115 115 115 115 119 99 & 9 . 39 . 42 & 85
Quinn Wire & Iron Works	82
Ric-wil Co. Ridge Tool Ce. Robert & C. Roberts Filter Mfg. Co. Roberts Filter Mfg. Co. Rost-Conserville Blower Corp. Russell & Axon	78 20 114 87 18 115
Salem Tool Co. Seaman Motors, Inc. Simplex Valve & Meire Co. Skinner Co. M. B. Smith & Gillespie Sporkler Mfg. Co. Straley Engineering Co. Straley Engineering Co. Strillson Assoc. Alden E. Syntron Co.	86 100 26 38 115 36 115 115 115
Taylor & Co., W. A. Tennessee Corp. Texas Vitrified Pipe Co. & Trickling Filter Floor Institute & Trojan Mfg. Co.	120 121 & 9 & 9 80
United Iron & Metal Co	96 46
Velsicol Corp.	45
Weston Co. L. A. Wheeler-Economy Pumps White Co. David Wolverine Tube Division Wood Co. R. D.	82 90 117 83 97 8 23



Cost of Testing and Repairing Meters in Detroit

Nearly 50,000 meters were tested last year by the Detroit, Mich., Water Department of which L. G. Lenhardt is Superintendent and General Manager. For testing flows from full to 1/32 inch, the cost per meter was 14.8 cents for 5/8-inch, 17.8 cents for 3/4inch and 29.7 cents for 1-inch.

Costs of installation were as follows: For %-inch \$16.91, of which 91 cents was for labor and cartage; 34-inch \$22.46, of which \$1.06 was for labor and cartage; for 1-inch \$37.59; and for 11/2-inch, \$69.82.

Cost of repairing meters was as follows: For frost damage, %-inch \$3.94 each for 1902 so repaired; for 3/4-inch \$4.60 for 219; for 1-inch \$5.93. For damages due to hot water, which occurred to 6,755 meters, costs were, for 5/8-inch \$4.44; for 3/4-inch \$5.50; and for 1-inch \$6.93. Repairs for damages "by wear and tear" were made to 22.114 meters, for which the costs were for 5%-inch \$4.11, for 34-inch \$4.38 and for 1-inch \$5.20.

Sludge Data, Richmond-Sunset Treatment Plant

In the fiscal year ending June 30, 1951, the raw sludge pumped to the digester at the Richmond-Sunset sewage treatment plant, San Francisco, averaged 4 per cent solids, and contained 80.5 per cent volatiles. Digester temperature averaged 92 degrees. The gas meter was inoperative for much of the year and data on gas production are unreliable. Digested sludge to elutriation had an average volatile content of 58.2 per cent and an average alkalinity of 1.180 ppm. The elutriated sludge had an average volatile content of 58.6 per cent, an average solids content of 5.21 per cent and an average alkalinity of 385 ppm. Ferric chloride dosage was 2.59 per cent; filter production was 4.12 lbs. per sq. ft. of filter per hour; and the filter cake averaged 71.0 per cent water.

How to Hold the Line on Rubbish Collection Costs

The purchase of twelve additional enclosed-type rubbish collection bodies by Newton, Mass., just about compensated for the additional labor costs over the previous year. The reason: "Less labor is required to operate this type of unit than is required for the open-type." Collection costs for rubbish for 1951 were \$7.85 per ton for 26,557 tons as compared to \$7.72 per ton for 26,288 tons in 1950. A wage increase of 12 cents per hour, or about 9 per cent, was made to the collection force in 1951. Garbage collection costs increased from \$10.65 per ton in 1950 to \$10.92 per ton in 1951, but the amount collected decreased 2.46 per cent.

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HI-WAY TAIL GATE SPREADER

(Motor driven)

VERSATILE

For streets, highways, airports, here is the all-purpose, allweather spreader that saves you money because it knows no season. Years of trouble-free service are designed and built into it.

No spreading operation too large or too small for it.

Any Speed - Any Width

Operates equally well at 1 mile per hour or 35, 4 to 60 feet in

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Saves time, labor, material, money.

Attaches Easily, Quickly

Attaches or detaches in one minute. Fits any standard dump truck body.

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HIGHWAY EQUIPMENT CO., Inc.

Cedar Rapids, Iowa







he was in their



Chicago office as a sales engineer. Before that, with Hitchcock & Estabrook, consulting engineers, Minneapolis.

* WESTINGHOUSE ELECTRIC appoints F. D. WEATHERHOLT sales manager. Industrial Products division, at Pittsburgh.

* 140 MORE GAR WOOD Load-Packers are being added to the 500 New York City already has. At this rate, we may get New York cleaned up yet!

* NEIL MUNRO has reached Bombay, India, as new managing director DORR OLIVER (India) Ltd. HARRY JUDSON relieves him as Dorr technical representative Johannesburg, So. Africa.

* ROBERT S. OBERLANDER, long with BALDWIN LOCOMOTIVE at Baldwin, Pa., is now in New York as application and sales representative for BALDWIN-LIMA-HAMILTON COR-PORATION Diesels for the eastern seaboard north of Washington.

* WATERWORKS MEN in Ohio and western Pennsylvania and New York can welcome JAMES L. MATTERN as DRESSER MANUFACTURING DI-VISION'S new representative there.

* M. B. MAC NEILLE, manager Pump Division, A. Y. McDONALD MANU-FACTURING COMPANY, has been awarded life membership in American Society of Mechanical Engineers.

★ TIMID AUNT: "Don't you ever worry about losing control of the auto?" Nephew: "I'll say I do. I'm three installments behind now."



* BUCYRUS STEEL PRODUCTS h a s moved into its modern new factory in Bucyrus, Ohio. Blades and cutting edges for motor graders, bulldozers, maintainers, and snow plows are the products of this new plant.

* THOMAS B. IRWIN is promoted to assistant western sales manager, UNITED STATES PIPE & FOUNDRY COM-PANY, at Chicago. BARTLETT BRETZ succeeds him at Kansas City.

* FOSTER ENGINEERING COMPANY, Union, N. J., has appointed GEORGE H. BAUER sales manager; N. L. A. MARTUCCI, sales promotion manager.

* LA PLANT-CHOATE MANUFAC-TURING COMPANY, Cedar Rapids, Iowa, has been acquired by ALLIS-CHALMERS to broaden its Tractor Division line. It's A-C's eleventh plant in the U.S.A.

* DALE SAMUELSON, formerly with MOTOROLA Inc., Chicago, is now sales promotion manager, HAMMAR-LUND MANUFACTURING COM-PANY, New York.





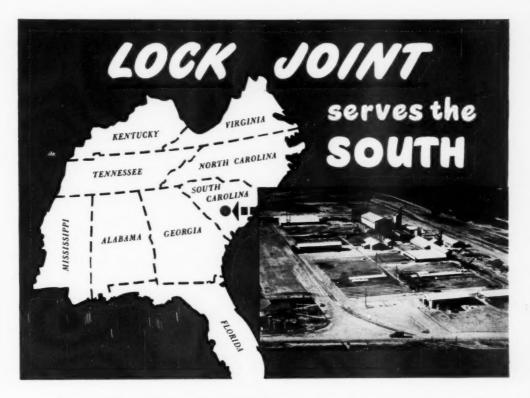
Mr. Samuelson

* WARREN B. REESE is new general sales manager, Macbeth Companies, Newburgh, N. Y.

* PREVENTIVE MAINTENANCE on "Cat" motor graders is the theme of CATERPILLAR TRACTOR'S new 16 mm, sound-color film. Your dealer can get one for you.

★ JACK G. REYNOLDS is new advertising manager, BROWN COMPANY. Boston-"Bermico" sewer pipe to you.

* TOM QUIGLEY of WALLACE & TIERNAN say it's getting so the sort of living the world owes you today isn't worth collecting.



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specifically Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Kentucky or Tennessee . . . our plant at Columbia, South Carolina, is ready and waiting to serve you. This Columbia plant, the fourth of our up-to-date permanent pressure pipe manufacturing yards, is equipped to produce Lock Joint Prestressed Concrete Cylinder Pipe in diameters from 16" to 48", designed for any pressure common to water works practice. The plant's central location in the Southeast makes it possible to deliver the completed pipe speedily and economically throughout this area.

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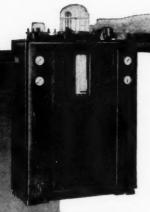
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